THE AMERICAN GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Thirty-fifth Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
EAST BOSTON, MASS., Jan. 10, 1905.

To the Members of the New England Association of Gas Engineers: The Thirty-fifth annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, February 14th and 15th, 1905. Those of our members who have changed their addresses will confer a favor on the Secretary by notifying him of such changes, so that they may have proper notification of the meeting.

Queries for the Question Box at the meeting should be forwarded at once. Respectfully, N. W. GIFFORD, Secretary.

[OFFICIAL NOTICE.]

Respecting the Official Work of the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
SECRETARY'S OFFICE,
530 Broadway, N. Y., Dec. 13, 1904.

To the Members American Gas Light Association: As there seems to be some misunderstanding respecting the standing of the official management of the Association, members will please note that the undersigned is the Secretary of the Association, and that Mr. A. E. Forstall is carrying forward the work of the Practical Class. All correspondence in connection with the Practical Class should therefore be addressed to Mr. A. E. Forstall, 58 William street, and all other matter pertaining to the Association to MR. GEORGE G. RAMSDELL, Secretary, at the above address.

[OFFICIAL NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY,
DELAWARE, O., Nov. 21, 1904.

The Editor of the Wrinkle Department, Mr. E. E. Eysenbach, General Manager of the Binghamton (N. Y.) Gas Company, earnestly solicits the co-operation of the fraternity for contributions to be presented to the Twenty-first Annual Meeting of the Association, which is to be held at the Hotel Schenley, Pittsburg, Pa., March 15th, 16th and 17th, 1905.

Editor Eysenbach will be pleased to receive contributions not later than February 10th. Work for the good of the cause and send him your "Wrinkles." T. C. JONES, Secretary.

[OFFICIAL NOTICE.]

Bureau of Information, Ohio Gas Light Association.

CITY OF LINCOLN GAS CO.,
LINCOLN, ILLS., Oct. 10, 1904.

To the Fraternity: At the last meeting of the Ohio Gas Light Association a Bureau of Information was decided upon, the idea of which is to render assistance to members who may have questions coming up

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SMITHSONIAN DEPOSIT.

or difficultles arising respecting which they would like some help. This Bureau has been established and is now ready for business. A number of co-Editors have been appointed to whom the various questions will be referred. As this is the first Bureau of Information attempted by any Association, it is hoped that the members will take advantage of its opportunities. The co-Editors are as follows:

Distribution.—E. E. Eysenbach and M. E. Malone.
Accounts and Bookkeeping.—D. W. Low and Chas. Ritter.
New Business and Gas Appliances.—Frank D. Moses, Ralph Woodward and F. Cavanagh.
Chemistry.—H. B. Harrop and Clarence Lomax.
Retort House.—Moses Coombs.
Natural Gas.—W. H. Hammon and Geo. W. Barnes.

All questions should be addressed to the Editor, at Lincoln, Ills.

Very truly yours,
H. L. Olds, Editor Information Bureau.

BRIEFLY TOLD.

A Warning.—Mr. F. H. Shelton, writing from Philadelphia, under date of the 9th inst., says: "I note that the Allan-Pfeiffer Chemical Company, of St. Louis, has been sending communications to the various participants in the exhibit of the Western Gas Association at St. Louis, asking contributions for testimonials to the Chief of the Liberal Arts Building. I wish to state that the management of the exhibit is not in sympathy with this matter, and is not in any way requesting those who kindly loaned exhibits or contributed to the success of the showing to donate for the above purpose. The general exhibitor was the Western Gas Association, and the Association is expecting to contribute moderately in recognition of courtesy and assistance extended by the Chief of the building, but it is not felt necessary that anything further should be done, especially by those who only loaned articles to the Western Gas Association, and so were not exhibitors in the ordinary sense.

Notes——

Three welcome additions to our walls' adorning are calendars from the Davis & Farnum Manufacturing Company, the Maryland Meter Company and the Safety Gas Main Stopper Company. As usual, Brother Dickey puts forth a charming effort, and "Fred." Davis is also to be congratulated on the stage beauties that the calendar sheets so safely carry.

"A. R. T.," writing from Wilkes-Barre, Pa., last week, said: "I notice that you did not make any mention of the death of Mr. George W. Beers, which sad happening took place here some time ago. His death brought sorrow to many, and especially to the residents of Nanticoke, Pa., where about 10 years ago he went to install the Nanticoke Gas Company's plant. Shortly thereafter he was made its first Superintendent and later was appointed Manager for the Peoples Electric Light, Heat and Power Company at Nanticoke. These positions he held until death claimed him. In the discharge of his duties patrons of these Companies received prompt consideration, while the interests of his employers were carefully guarded. He was a brother of W. D. Beers, of Wilkes-Barre, and lived there at 82 Grove street. Death was caused by Bright's disease at the age of 55 years. Besides his wife he is survived by one son and three daughters."

Mr. Lendabarker, for several years a trusted employee in the fittings' department of the Peoples Gas Light and Coke Company, of Chicago, died some days ago from pneumonia, in the Alexian Brothers' Hospital, Chicago. He was a brother-in-law of Alderman Maypole, of Chicago.

A Springfield (Mass.) correspondent says that the gas users in Holyoke, Mass., will within the year be granted another reduction in gas rates, if the figures that will be presented in the annual report of the Municipal Lighting Department by Manager Snow are given due consideration. The ruling rates must run until July 1, and it is likely the revision will be declared at that time. Continuing, our correspondent says: "The first 4 months under the rates for 1904–05, the income from gas fell off as compared with the same months the preceding year, but then they increased. Should the increase continue, as seems likely, Holyoke gas consumers will receive another reduction without much doubt by next summer. The new electric light rates have not been in effect more than a month or so, and it will be some time before it will be known whether the department will consider a reduction in them. It can be stated that the outlook is favorable to reductions in the price of both gas and electricity the current year."

Carbonizing in Bulk.

The *Gas World* notes that at the last meeting of the Bavarian District Gas Association, Herr Ries, the manager at Munich, gave an account of the results obtained with large distilling chambers. Three of these were built above the ordinary Munich producer (in which the primary air is preheated), in the place of the usual bench of 8 retorts.

Each chamber has a sloping floor, and takes a charge of 44 cwts., which remains for 24 hours. The whole charge is dumped in at once, and, incidentally, the charging is so quick (15 to 20 seconds) and produces so much cooling that there is very little smoke or flame to disturb the workman when he is putting in the charge. The coal readily settles to the required level, and the evolution of gas is so fair throughout the 24 hours that the whole working is very smooth. There is no trouble with tar deposits; and the coke at the end of the 24 hours gives no appreciable flame, and has loosened itself from the walls of the chambers so as to leave a space of from 0.4 to 0.8 inch. This enables the coke to be drawn down the sloping floor with great ease and expedition. This implies that the distillation shall have been allowed its full time, 24 hours; if we attempt to draw the charge prematurely there may be difficulties. The carbon is small in amount, and readily burns off when the chamber is opened; about the roof of the chamber, however, the deposit is thicker. The coke comes out in large and very hard blocks; but there is a good deal of it to handle at each discharging.

Comparative Tests.—The bench of three distilling chambers was run parallel with a bench of eight ordinary retorts, using the same kinds of coal. The table on following page, which is summarized from a long series of particular tests, shows the average results obtained per ton (English) of coal used

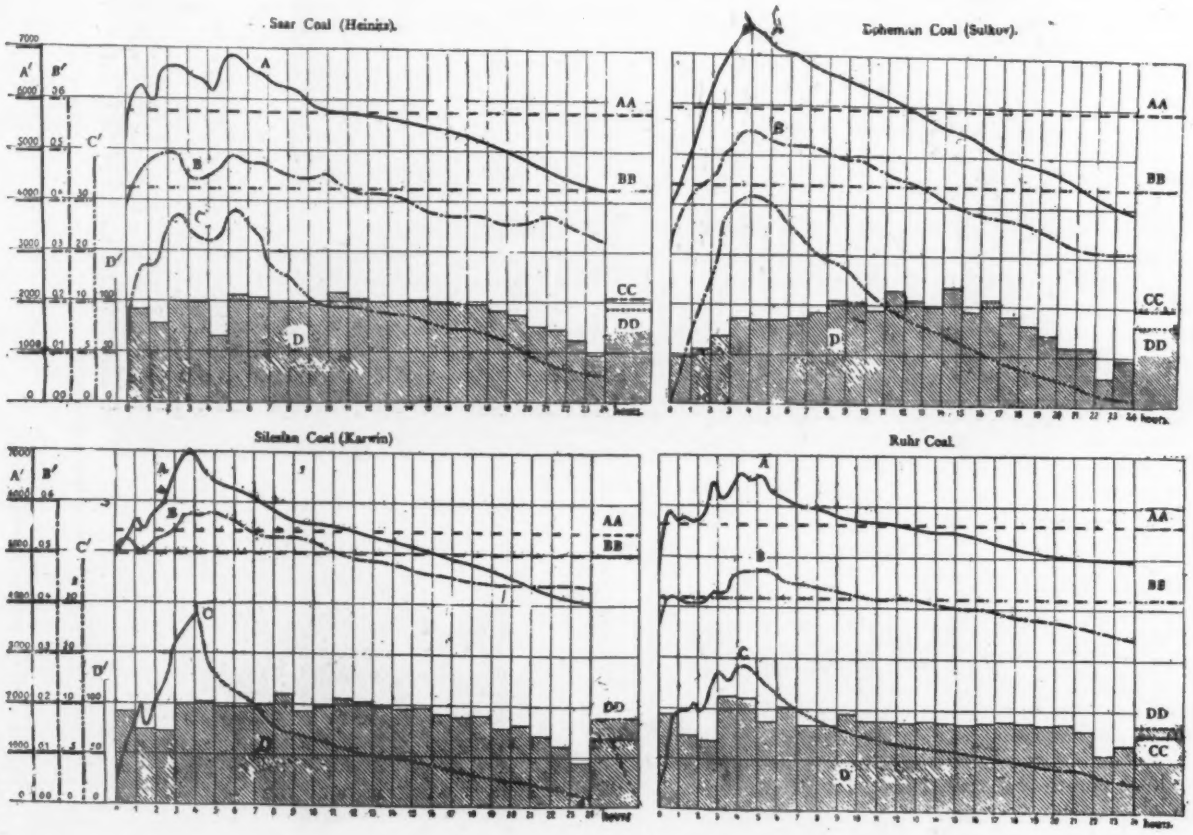
In some of the particular tests on which the table is based the yield of coke was just a little short of that from retorts; but the difference is to some extent accounted for by the want of proper appliances for prompt extinction of the large quantity of coke when it is drawn. The yield of tar is smaller, the tar being itself partly gasified. The amounts of ammonia have not as yet been ascertained. The candle power shows a fall-off of from 20 to 35 per cent.; but this is of small importance nowadays. The heating value does not show any such amount of depreciation, the average amount of this being no more than 6 per cent. It is curious to note how nearly the heating values of the gas per ton of coal correspond to one another. Thus with Saar coal we have, per English ton, 6,971,376 heat units in the gas; with Bohemian coal, 6,794,983; with Silesian coal, 6,356,452; and with Ruhr coal, 6,385,830. This widens our area of selection among the different kinds of coal.

During the Twenty-four Hours.—The diagrams show, for the four kinds of coal experimented upon, the averages obtained from hour to hour during the five months over which the tests have extended. The production of gas goes on all the time with considerable uniformity.

The specific heat, the lighting power and the heating value all rise at first, and then fall off after about 3 or 4 hours. The data relate to the mixed gas from the three chambers, of which the second and the third are respectively charged one hour and two hours after the first. The amount of coke used for distillation was about 24 cwts. in 24 hours, and the quantity of coal distilled during the same period was 6.6 tons. This makes a consumption of 18.2 per cent. of coke—a rather high figure, due to the bench of chambers standing by itself, and therefore losing heat by radiation. There is a considerable saving in labor, the details of which will have to be ascertained by experience on a larger scale. At present the results are so favorable that it has been resolved to replace several benches of old retorts at the Kirchstein works by benches of these chambers.

Dr. Schilling, in the course of the discussion, said the whole question of method in gas making had become acute, and here was a solution so far based on coke oven methods that the wonder was it had not been applied before. The Munich gas works had shown that it was possible to make a gas answering all requirements by distilling in bulk. It was quite natural that the gas, having to pass through greater bulk, should become richer in hydrogen and poorer in high hydrocarbons. Coke ovens had hitherto only utilized a portion of their gas for illumination, and had used the rest for firing; but it had now been shown that the whole of the gas could be used for lighting. The gas would bear enrichment to any required extent. Twenty-four periods seemed to provide ideal conditions of working, for the chambers once charged needed nothing more for a long time than watching.

	Coke, Cwts.	Tar, Pounds.	Liquor, Pounds.	Gas, Cu. Ft.	The Gas has—Candle Power (5.297 Cubic Feet in Slit Burner). Candles (English).	The Gas has—Heating Value, B.T.U's, at 32° F. and 29.92 Ins. Pressure.	Specific Gravity at 9° F. and 29.92-Inch Pressure.
Saar coal—Chambers	14.101	16.195	10.618	10,768.1	9.090	647.41	0 447
" Retorts	13.420	13.664	12.902	10,793.2	11.757	679.44	0.460
Bohemian coal—Chambers	12.778	11.110	30.106	10,012.5	8.677	678.65	0.465
" Retorts	12.276	18.032	23.167	10,055.4	10.692	682.02	0.449
Silesian coal—Chambers	13.836	7.996	15.030	10,432 2	6.098	609.33	0.527
" Retorts	13.640	12.499	12.320	10,671.4	9.698	648 31	0.468
Ruhr coal—Chambers	14.162	8.624	15.839	10,073.4	6.697	633.93	0.442
" Retorts	14.168	12.701	9.408	9,482.5	8.721	656.52	0.412



A.—Curves of heating values during the 24 hours.
AA, the average heating value during the 24 hours.
A^1, scale of heating values, in calories per cubic metre [1,000 = 112.36 B.T.U's per cubic foot.]
B.—Curves of specific gravity during the 24 hours.
BB, the average specific gravity during the 24 hours.
B^1, scale of specific gravities [air=1.00.]
C.—Curves of candle power during the 24 hours [flat flame, slit burner, 5.297 cubic feet per hour]
CC, average of candle power during the 24 hours.
C^1, scale of candle powers, in Hefner units [10 Hefner units = 8.8 candles, British.]
D.—Hourly yield of gas during the successive 24 hours, from 6.6 tons of coal in the 3 chambers.
DD, average hourly yield.
D^1, scale of hourly yields in cubic metres [100 cubic metres = 3,531.6 cubic feet.]

Pressure Raising Plant at the Dover (England) Gas Works.[1]

By the courtesy of Mr. Raphael Herring, the Engineer of the Dover Gas Company, we are able to give some illustrations of a plant which has recently been installed at his works for increasing the gas pressure in the trunk mains leading from the works.

At Dover, besides the storage gasholde s at the works, there are in the town, at about 1½ miles distant therefrom, two holders, from which the gas is delivered into the town. It was found during last winter that there was much difficulty in filling these holders through the trunk main; and it could only be accomplished during the time of maximum gasholder pressure at the works, and this was not always possible. The problem that presented itself was whether the large expenditure involved in the laying of a new trunk main should be incurred, or whether the result could be obtained by intensifying the pressure by means of machinery.

It was under these circumstances that Mr. Herring consulted with the Sturtevant Engineering Company, and ultimately arranged with them for the supply of one of their steam driven gas exhausters. This, according to the statements made by the Company was the first gas exhauster so coupled to a steam turbine; but the example established at Dover has since been followed at Plymouth and Leicester.

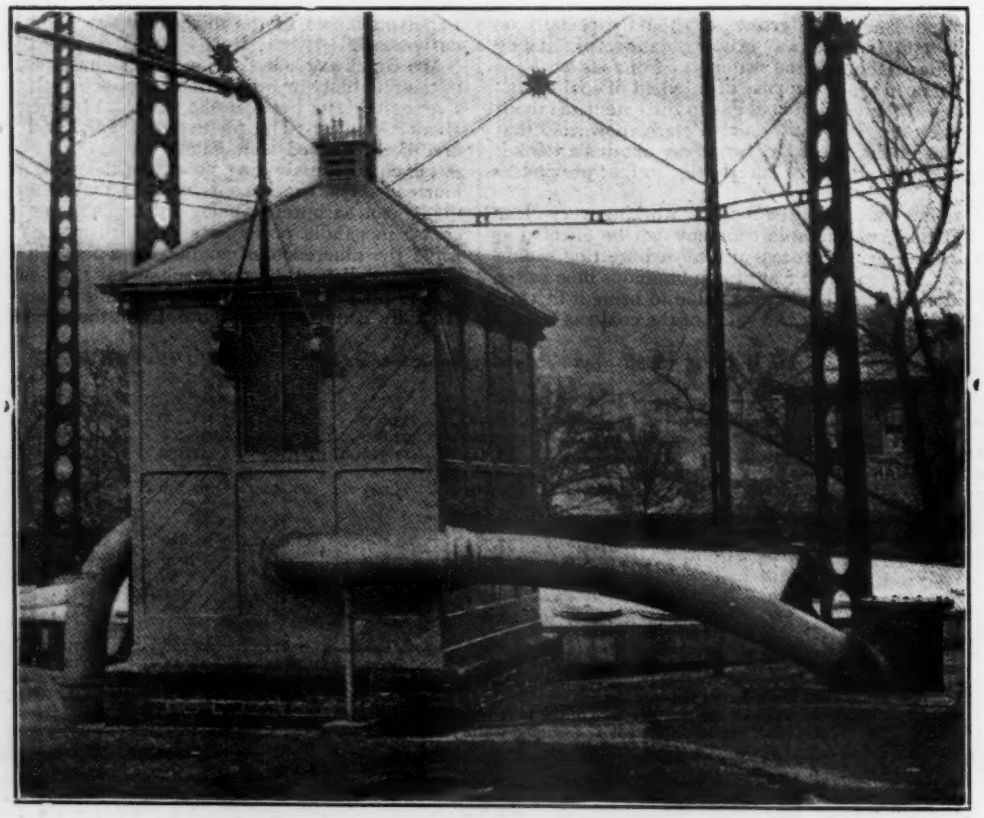
Having made this arrangement with the Sturtevant Company, the Dover Gas Company entered into a contract with Messrs. Samuel Cutler & Sons, of Millwall, for the installation of the entire apparatus; and the latter firm supplied and erected the two buildings containing the machinery and the steam boiler, the steam boiler itself, and all the various additions and alterations required to the gas connections, as shown by the several illustrations.

The result has been eminently satisfactory in every respect—completely fulfilling all the expectations formed. The turbine runs at a speed of about 32,000 revolutions per minute—resulting in an exhauster speed of some 4,000 revolutions per minute; the consumption of steam being extremely small.

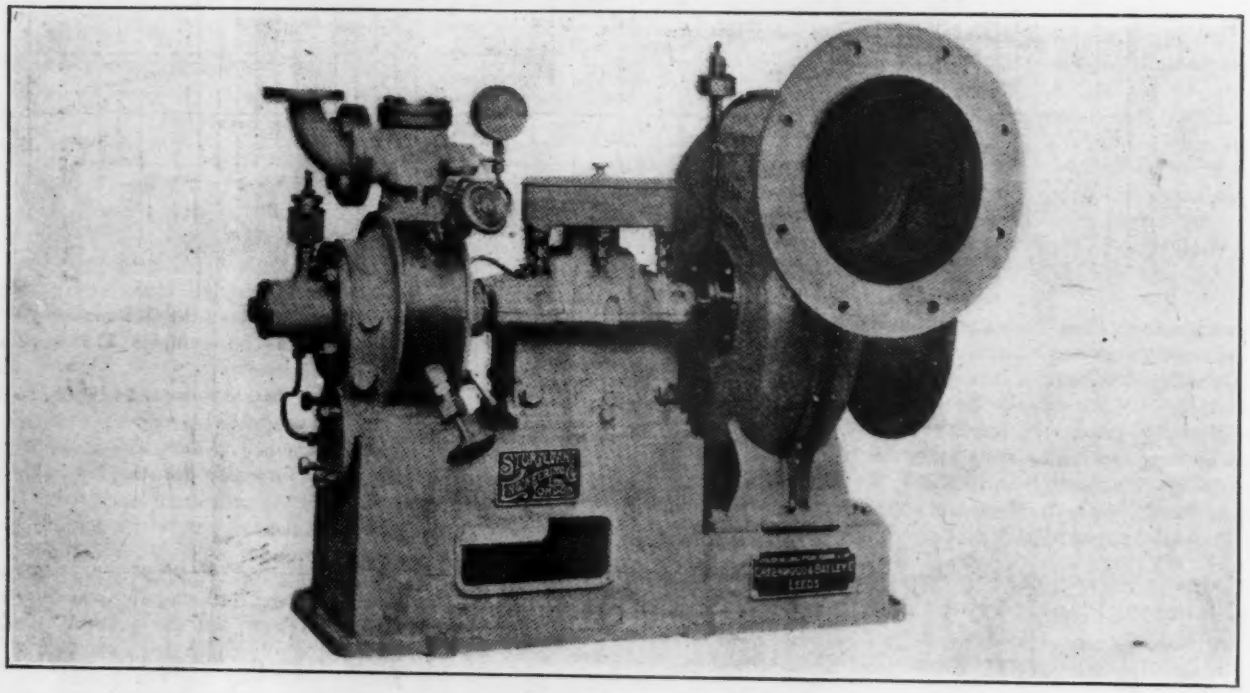
During a test, it was found possible to maintain a pressure in the trunk main of 240-10ths; but, in practice, this pressure was not required —from 100-10ths to 130-10ths being quite sufficient, and this only during the period of maximum consumption.

The following table gives some of the working figures that have been obtained:

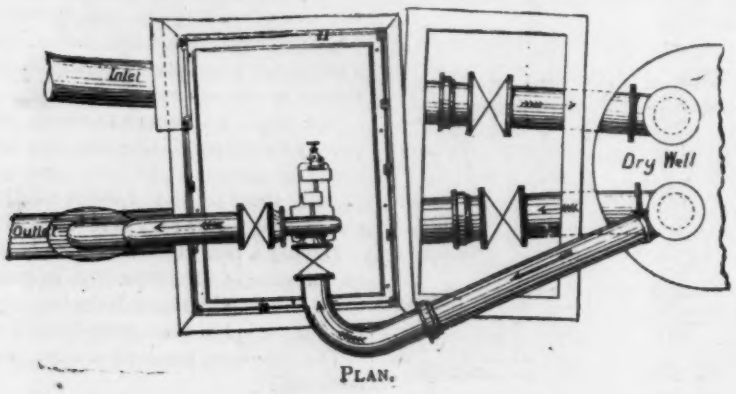
1. *Journal of Gas Lighting.*



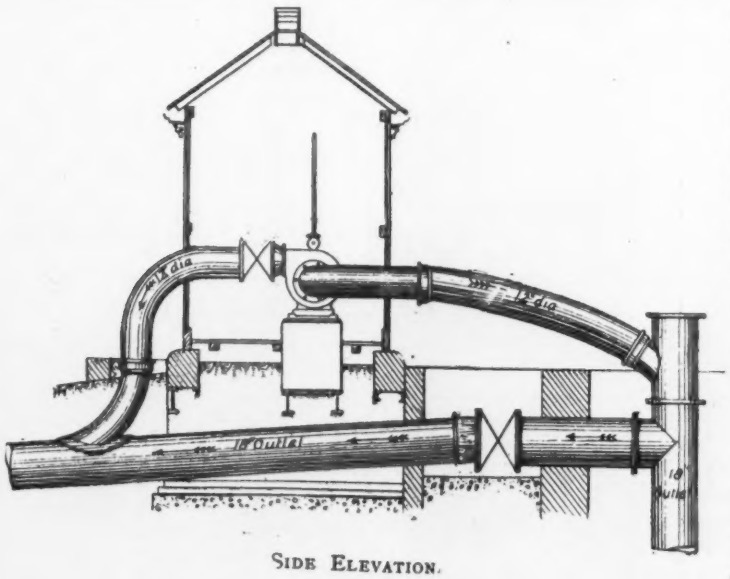
THE TURBO-EXHAUSTER HOUSE AT THE DOVER GAS WORKS.



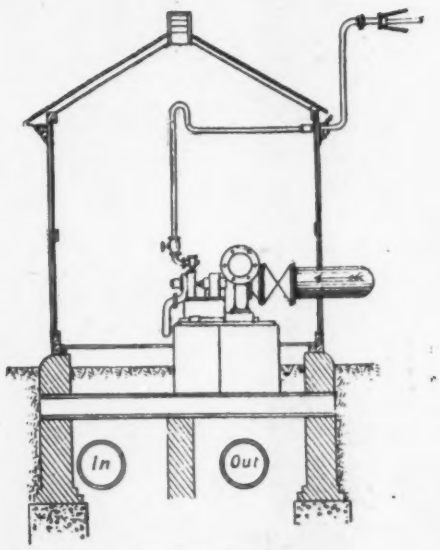
THE STURTEVANT INTENSIFYING PLANT.



PLAN.



SIDE ELEVATION.



END ELEVATION.

Date.	Working Hours.	Gas Pressure. Tenths.	Quantity of Gas Compressed. Cubic Feet.	Steam Pressure.	Fuel per 1,000 Cubic Feet of Gas Compressed.*
Nov. 29...	3 P.M. to 9 P.M.	100 to 130	483,000	110 lbs.	11¼ oz.
" 30...	3 P.M. to 7 P.M.	" "	287,000		
Dec. 1 ...	3 P.M. to 9 P.M.	" "	470,000		
" 2 ...	3 P.M. to 9 P.M.	" "	486,000		

*This includes lighting the boiler fire four times.

The originals of the illustrations shown were exhibited at Messrs. Cutler's stall at the Earl's Court Gas Exhibition, and the plant at Dover is quite open for inspection (by appointment) to those interested therein.

The Development of Illumination.

By MR. WALTER HOUGH.

Before the period of artificial illumination there were many manifestations of light in nature coming to the aid of the denizens of the earth during the hours of darkness. Of these were the so-called luciform appearances, including the aurora borealis and australis, which enliven the long nights at the polar zones; the Magellan clouds of the Southern Hemisphere; the zodiacal light, whose cause was long a subject of speculation, and the diffused light of the milky way, known to the Chinese as the "river of the sky."

The light from the stars and planets is not inconsiderable. Under the clear night sky of the Arizona deserts the atmosphere seems charged with star mist; eminences miles away may be outlined, the dial of a watch may be read, and a trail followed with little difficulty. These are the conditions under which night journeys are made to avoid the burning sun. The planet Venus, at inferior conjunction especially, sheds light sufficient for the traveler over open country.

There are at times nights of remarkable luminescence. Clouds become phosphorescent, and often under certain states of electric stress, during high winds, glimmer with a faint light not amounting to a discharge of the electric fluid. Frequently successive flashes of "heat lightning" aid the traveler in finding his way. It is possible, also, that the soil over certain regions may become phosphorescent under the light of the sun and retain the property during the night, as certain gems are phosphorescent after being submitted to sunlight. Snow has this property. Gaseous emanations of a phosphorescent character are occasionally abundant enough to produce temporary illumination.

Next to the sun in value to man as a light producer is the moon. Though intermittent in the power and duration of its light, the moon has proven a valuable auxiliary on the night side of man's life, and its period has given a measurement of aggregates of time.

In torrid climates, and at hot seasons of the year, work is often carried on by moonlight in order to escape the heat of the day. While moonlight is 450,000 times less bright than daylight, under certain favorable conditions the light seems intense and ample for many purposes.

The well-known phosphorescence of lichens has been found to give considerable light during warm, moist nights in the summer. Certain flowers are phosphorescent, or emit flashes of light, as the tuberose and moonflower. In the vegetable world there are numerous sources of light whose faintness causes them to escape ordinary observation. As an aid to man, however, the light from the vegetable kingdom is far less useful than that yielded by the animal kingdom.

When the animal kingdom is reached, numerous examples of light phenomena connected with vital processes are found. The familiar firefly of northern latitudes frequently renders summer nights luminous, while the tropical noctilucidæ yield an actual and valuable illumination which has been utilized as light in several interesting ways by the inhabitants of regions in which the insects are found.

The distinguished traveler Kaempfer described the fireflies of Siam as "settling upon the trees like a fiery cloud," and in Brazil, Gardner compares them in brilliancy with "stars that have fallen from the firmament and are floating about without a resting place." Kidder says: "In the mountains of Tijuca I have read the finest print of *Harper's Magazine* by the light of one of these natural lamps placed under a common glass tumbler, and with distinctness I could tell the hour of the night and discern the very small figures which marked the seconds of a little Swiss watch. The Indians formerly used them instead of flambeaux in their hunting and fishing excursions, and when traveling in the night they are accustomed to fasten them to their feet and hands. And they are used by señoritas for adorning their tresses. Prescott narrates the terror they inspired in the Spaniards in 1520. 'The air was filled with 'cocuyos,' a species of large beetle which emits an intense phosphoric light from its body, strong enough to enable one to read by it. These wandering fires seen in the darkness of the night were converted by the besieged into an army of matchlocks,' so says Bernal Diaz."

The bearing of the light of the firefly on the light of the future is very important, and the investigations carried on at the Smithsonian Institution a few years ago may introduce a new epoch in illumination. A brief account in the Philadelphia *American* states that "some interesting experiments upon the nature and origin of the light emitted by the firefly have lately been made by Prof. S. P. Langley. From the spectroscope he finds the light to be of exceedingly narrow range of refrangibility. The heat given out is scarcely appreciable, being less than ½ of 1 per cent. of that produced by an equal amount of light from a candle or other common illuminant. That the light is a chemical product would seem to be established by the fact that it decreases by-products which check combustion (*e. g.*, nitrogen) and increases by-products which aid combustion (oxygen), and that the product of the process is apparently carbon dioxide. The subject of the origin of 'phosphorescent' light is one that may develop very interesting features, for, as graphically stated by Prof. Oliver J. Lodge, if the secret of the firefly were known, a boy turning a crank might be able to furnish the energy necessary to light an entire electric circuit.[1] From this standpoint Prof. Lodge regards as enormous the waste of energy in the machinery of electric light making now in use."

Most of the 150 species of animals which are light-producing inhabit the sea, where their light is of small importance to man. The wonderful phosphorescence of the tropical seas, which has drawn forth many

1. The municipal plant agitators of New York may notice this.

descriptions of its beauty, is caused by the collective lights of myriads of infusoriæ on the surface of the water.

The day opens up a vast field of activities requiring light for their prosecution. Solar light is normal for the carrying on of these activities, and the night is normal for rest and recuperative processes. The important phenomena of the day are sunrise and sunset; and the day's labor regulates itself to twilight, morning and evening hours, and the hours of broad day divided by the meridian of the sun. Sunrise is attended with certain phenomena, which observant people have noticed.

The Hopi tribe of Arizona, for instance, employ the following terms for sunrise: Sunrise, *talavaiya;* place of sunrise, *tawa yum tyaki;* faintest dawn, *kûyañiptü;* first light, *talti;* light of sunrise, *taláove;* yellow light of sunrise, *sikyañüptü;* before emergence of sun, *tawa küyiva*, "sun appears;" sun-up, *tawa yama.* Few tribes indeed have not been impressed with dawn and sunset, and few in the oblique latitudes have failed to mark the seasonal progress of the sun along the horizon.

There is a wide difference in the amount of sunlight enjoyed by the dwellers on the earth's surface, depending on the height and configuration of the land, its absorptive and reflective qualities, the presence of forests and vegetation, the amount of moisture and dust in the air, cloud formation, and other elements which suggest themselves to the reader, producing local and periodical variation. To these must be added the seasons and the position in latitude determining the length of the day and the duration of twilight.

The superabundance of sunlight has brought about many devices for warding off and tempering the rays and ameliorating their heat. For protecting his eyes from the excessive light man has devised eye shades, hats and parasols; and for shade and protection from the heat, shelters of brush, skin or cloth. In some environments the chief function of the house seems to be for shelter against a burning sun, and this points out a probable origin of the house in tropical countries.

Nowhere is this regulation of daylight more thoroughly carried out than in our modern houses of the temperate regions, whose development has been along the praiseworthy lines of more light and air. What the ancients directly accomplished by small light openings requires now hangings, lace curtains, inside shutters, blinds, perhaps sash curtains, outside shutters and awning. These may further be reinforced by shade trees. With all these adjuncts one might be led to believe that the dim light of the early houses is still preferred by the moderns.

As a corollary of protection from the sun follows the observation that tribes living in the shade become lighter in color than their fellows living in the open country. It is also true that there is a characteristic facial modification, such as wrinkling and contorting about the eyes produced in these who are exposed to the glaring light of the deserts or the sea.

Without doubt man is a diurnal animal; his eyes have not the condensing power of those of the *Felidæ* and other nocturnal beasts. The man apes are also day animals, and these tribes of mankind retaining a degree of primitiveness regulate their rest to the setting and rising of the sun.

With the use of fire begins the history of artificial illumination. The nocturnal light of nature became then of little moment in comparison with fire lights and the burning brand in the hand of man; the conquest of light over darkness was signalized, and the night side of man's life and his progress toward culture became a theme of surpassing interest.

There perhaps cannot be a satisfactory reconstruction of the period before the knowledge of fire, and the difficulty persists in the subsequent stages of the acquisition and use of fire, and the generation of fire at will—stages grasped by the philosophic mind of Paul Broca.

One fact stands out clearly—that man unacquainted with fire is unknown. With the light of the camp fire comes the torch, and from this starting point, by the help of observations on less civilized peoples, it may be possible to reconstruct the history of artificial illumination and to check it in some degree by the aid of archæology.

The following table, briefly epitomizing the development of the candle, is presented as the result of extended research in this direction:

Development of the Candle.

Protoillumination in line of torch:

Fireflies used as torches. Fat bodies of birds and fish burned for light. Prototorch (adventitious and temporary):

1. Firebrand, branches, resinous wood, bark, leaves, etc.

Torch (for customary use):

2. Slivers or other elements tied together in a bundle.

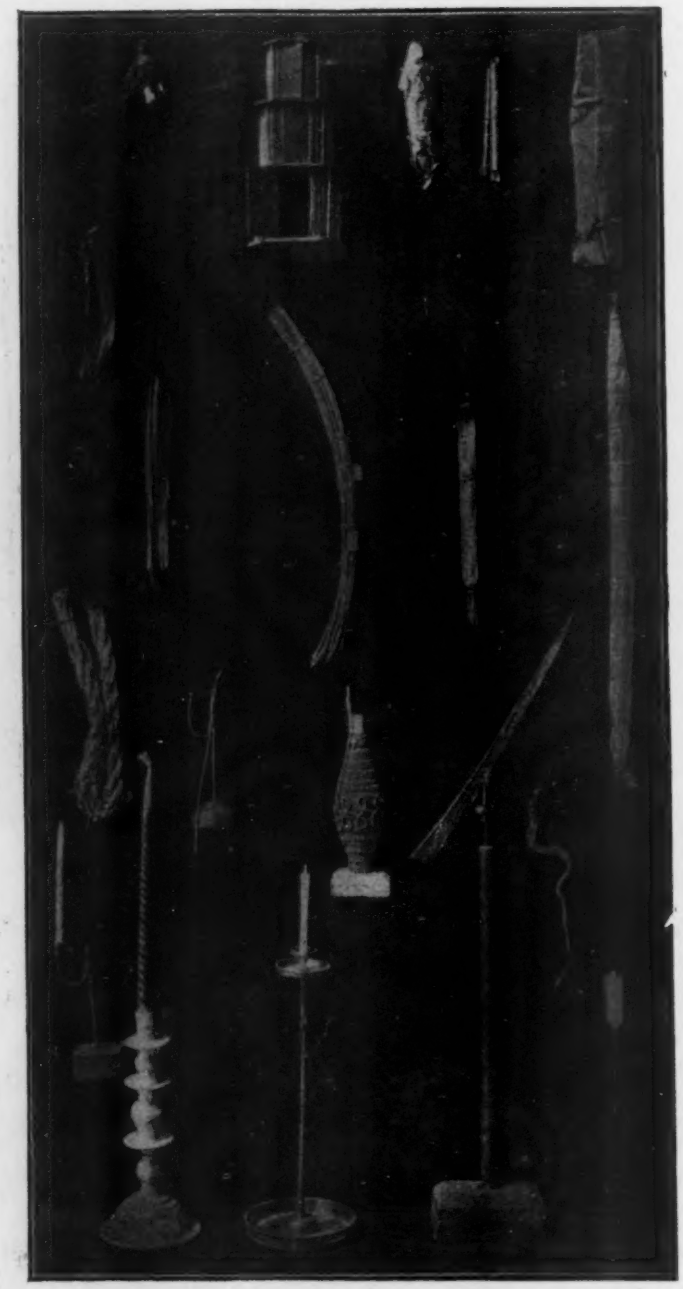


Plate I.—Torches and Candles.

3. Roll of resin wrapped up in leaves.

Protocandle:

4. Rope soaked in resin.
5. Fiber soaked in fat or wax.
6. Rush soaked in grease.
7. Stick or splint with grease for lighting.

Candle:

8. Mass of fat formed upon a stick around which is wound a wick of fiber.
9. Candles of wax or fat.
10. Dipped candles.
11. Molded candles; improved and art candles of twentieth century.

While the line of development has proceeded from the rude torch to the candle, the steps marked in the series are suggestive embracing devices used by different peoples and at divers times. There is not space here to present the results of investigations among different peoples and in special areas. It will be seen that the purpose for which light is to be used, the place in which it is to be used, the period, and the resources of environment, are among the modifying influences on materials and apparatus. Hence the complete steps of the development may not be exemplified in a given area, though a number of superposed phases of light utilization may exist side by side. It is true, also, that the growing need for light has brought a closer association of the means of illumination with the life of man. The smoking torch, for example, is utilized for open air illumination, while the candle enters the house and companionship of the family.

Plate II.—Series of Lamps.

Following the torch in the line of development comes the lamp, which separated from the stem of the torch at a period when oils and fat came to be used. This may have occurred (1) as a concomitant of migration or after the domestication of animals whose fat was available; (2) at the time of the discovery of mineral oil, (3) or of the utilization of vegetable oils, such as that of the olive and the cocoanut.

The lamp appears to have arisen at a period after migrations into the temperate zones has brought man into new conditions The principal of these was the longer night, and joined to this was the settlement in permanent habitations. In this view the fire stick and torch were the essential accompaniments of early migration and without doubt determined the spread of man over the earth's surface.

Since the torch, from its perishable character, is rarely found on ancient sites, there is little to be said as to its archæology. The lamp, on the contrary, being a higher idea, involves work in stone, pottery, bronze, or iron, producing objects which survive burial in the soil. Discoveries by French archæologists have shown that the lamp was in use at the close of the lacustrian bronze age, and up to the present time these are the most aucient objects which have been found that are unmistakably lamps.

It would seem that the lamp with a wick had its origin at a culture plane represented by that of the bronze age, though such employment of fire might have been prefigured by usages in the age of polished stone. Again, the latitude and consequent difference in temperature of stations have exerted controlling influence on the character of the early lamps which it might be possible to employ. Thus climatic conditions render the fuel supply of the lamp solid or fluid and broadly determine the form of the reservoir.

It is almost safe to say that the higher types of illuminating apparatus would not have developed except in the temperate zone or the region of long nights. The tallow candle is a device of cold regions; the same may be affirmed of the open fat lamp. The form of the latter seems to depend upon the character of its fuel supply, and this cause no doubt constantly gives rise to forms of extreme primitiveness in the midst of a high civilization, aside from those descending from the primitive type and retained in use through the working of the large body of survivals of custom in every society.

Development of the Lamp.—The series might have grouped at the beginning devices for producing a temporary light and those undifferentiated lamps of skulls and bones. The bodies of birds and fish burned by means of a wick also may be classed with the lamps.

Temporary Light.

1. Oil bag from which oil is thrown on a fire to produce a temporary light. Kwakiutl Indians, British Columbia. Lighting apparatus of skulls or bones suggestive of primitive lamps.

2. Lamp. Unworked beach stone with a concavity, supplied with oil and having the wick laid along one edge. Aleutian shell heaps.

3. Lamp. Hollowed beach stone with moss wick arranged along one edge. Worked stone lamps. Eskimo.

4. Lamp of pecten shell with oil and wick of rush pith. Ainos, Japan. Fusus shell hanging lamp. Orkney islands.

5. Lamp. Terracotta saucer. China, India, etc.

6. Terracotta saucer with edge pinched up into gutter or gutters for wick. Syria and India.

7. Lamp. Terracotta. Reservoir almost closed over; spout for wick. Lamps of pottery with reservoir closed over. Lamps of bronze with one or more wick spouts. Roman.

8. Lamps of iron of simple shape with plain open or closed reservoir and with spout, and often having dip catchers and a device for tipping to allow the oil to reach the wick. There is considerable variety of such lamps, which were used in Europe before the epoch making invention of Argand. Being products of the blacksmith's hammer, they present a certain crudity, as of antiquity. However, there is no reason to doubt that they are the survivals of the forms of the iron age.

It may be interesting to briefly pursue the line of the lamp into the inventive age.

Lamps of the Inventive Era.

9. Lamps of brass with reservoir mounted on rod and stand; several curving spouts. Italian. Development from the Roman lamp.

10. Lamp of brass designed to furnish heavy oil to the wick under hydrostatic pressure. Flemish.

11. Lamp with chimney; draft to flame and heavy oil under gravity pressure. Argand's invention and French inventors.

12. Lamp with chimney and Argand burner; heavy oil under forced pressure of a spring. Devices for heating heavy oil. France.

13. Lamp of glass having one or two tubes; for burning whale oil.

14. Lamp burning "camphene" by means of wick and tubes and without chimney. United States.

15. Lamp with chimney; ventilated burner; woven wick raising refined petroleum by capillarity. United States, 1870. Developed burner to end of century.

At present the destiny of illumination is in the hands of the investigator and inventor. Who knows to what heights their efforts will lead? But before the inventive era, before Argand, if you please, the world satisfied its needs for light with the immemorial simple lamp and smoky torch, increasing the illumination at times by multiplying the number of lights, and casting over scenes of splendor the flare of torches little removed in simplicity from those of prehistoric man.

It may be a wholesome correction of our pride in the advance of a century to reflect that most of the human race is still in the uninven-

tive period, depending for their light on torches and simple saucer lamps.

The epoch making invention of the chimney and the discovery of boundless hydrocarbons in the earth have not yet reached the majority of mankind, while the electric light casts its bright rays in a very small area of immense obscurity. Still there is progress, and gradually tribes from their beginnings unacquainted with more than the most simple illuminating methods are seeking more light.

It is interesting to note in this connection the education of the Hopi Indians of Arizona in the use of artificial illumination. The environment of these Indians is semi-arid, and there is such scarcity of fuel in their isolated country that it must be used sparingly for cooking and only as a luxury for illumination. Hence, up to a few years ago, all avocations ceased at dark. Four years ago the writer, while encamping at Walpi, noticed only a solitary light at night in the pueblo. There was at that time a demand for candles. Two years later a number of lights shone from the windows of the village. Lately coal oil has become known; a great many families possess the luxury of a coal oil lamp, and this has worked a great change in the habits of the people. This seems in epitome the history of early illumination.

Lump Sum vs. Unit Price Bidding.

Engineering News says that a noticeable feature in the bids received for the New York Barge Canal work, which were recorded about mid-December, was the rarity of lump sum bids. Contractors were at liberty to submit either itemized bids or lump sum bids or both; but, with few exceptions, they chose to bid by items. This fact has been seized upon by some as indicating the desirability of awarding contracts to lump sum bidders only; for, it is argued, the contractor who bids by items has an excellent chance to receive a final payment much greater than the total estimate at the time of letting the contract. In proof of this the old Erie Canal contracts are cited, also the contract for the New York Subway. The latter, it is claimed, is an excellent example of the advantage of lump sum bidding.

Now, as a matter of fact, neither the old Erie Canal contracts nor the recent subway contract prove the advisability of lump sum bidding. In reasoning, the greatest errors often arise from attempts to generalize from one or two particular examples. The public, which has unfortunately suffered from the errors made by engineers in estimating the cost of great public works, has come to regard with suspicion all engineers' estimates regardless of the ability of the engineers, the character of the estimate or the time devoted to making it. When, therefore, they see a great piece of work carried through at a cost not greater than the original estimate they institute comparisons between this exceptional piece of work and the others that have preceded it Knowing little or nothing about the engineers or their respective methods of making estimates, they reason about those self-evident features of the contracts under which the work was done. Finding that a lump sum bidding price in the subway contract and itemized bidding prices in the old Erie contracts, the inference is made that lump sum bidding bars out all chances for extra payments, and is, therefore, the secret of successful performance of the work at a cost within the engineers' original estimate.

Such reasoning obviously ignores the other features of specifications, class of work, methods of estimating the cost, etc. In a word, the reasoning is fallacious, as can be readily shown even to those not familiar with engineering problems.

Let us enumerate the principal items that are found in nearly all final estimates which exceed preliminary estimates. They are: (1) Increased quantities of items originally underestimated as to quantity; (2) new items not found in the original estimate; and (3) increased prices allowed (a) because of the passage of laws shortening the hours of labor, or (b) because of deceptive conditions set forth in the original plans, specifications, earth borings, etc.

With the exception of item (3a)—increased prices due to the passage of labor laws subsequent to the letting of the contract—every one of these causes is directly chargeable either to incomplete engineering study of the original conditions and plans, or to a decision altering, in whole or in part, the original project. Thus, if the engineer lacks time, money, foresight or ability, he may make a hurried survey of the work, and perhaps no survey at all of the subsurface materials. In such a case the actual work is quite certain to disclose things not looked for, thus necessitating changes in plans, generally leading to increased cost. Changes of plans arising from the whims of owners, to which architects are so often subjected, seldom serve as excuses for engineers whose preliminary cost estimates prove to have been too low. In passing we may say, however, that the public which is quite familiar with the bills of "extras" rendered by builders of houses, and with the proverbial excess of cost of architectural work over the original estimate, is quite apt to think that engineering work is of the same feather. But to anyone who has made a study of engineer's preliminary estimates and the final cost of the structures, it is at once apparent that changes of plans resulting in increased cost have almost invariably been forced upon the engineer, not by the whim of someone who holds the purse, but as the result of his own ignorance of the conditions to be encountered, and occasionally because of his own ignorance of how to design structures to meet known conditions. This ignorance of conditions does not necessarily imply lack of ability on the part of the engineer, for he may be, and usually is, capable of ascertaining what the conditions are if given time and money enough for making a thorough survey.

Coming back to the $9,000,000 Erie Canal work and the New York subway, an engineer familiar with the methods of making the original estimates for each sees at once that itemized bidding and lump sum bidding were mere incidents in the performance of these two different classes of contracts. The essential difference between the two lies in the methods of making the original estimates. Before the $9,000,000 appropriation was made for the Erie Canal deepening, two engineers were asked to submit to the Legislature separate estimates of cost of the proposed work, and it has been repeatedly stated—but never denied—that less than 2 weeks' time was allowed in which to submit the "estimates" to the Legislature. One "estimate," made by an ex-State Engineer, was $9,000,000, the other, by the then State Engineer, was $12,000,000. The Legislature adopted the lower guess of the two, and ever since, the $9,000,000 "estimate" has been held up as another shining example of the inability of engineers to estimate costs with accuracy. We see that in this case there was really no survey at all—simply a guess based upon a 2-weeks' "study" of assumed conditions that were afterward found to be grossly in error. We are not excusing the author of the guess, nor would we revive a dead issue except that its ghost still haunts every great public project in the State of New York.

On the other hand, we have the New York subway as an excellent example of how to make an estimate of cost worthy of the name estimate. Numerous borings were made along the whole route of the proposed road, and local conditions were examined with the greatest care by a large corps of engineers under competent leadership. Study was made of the actual cost of subway work in Boston, and of all classes of excavation in New York city itself. Upon these data an estimate was made, and we do not hesitate to say that had the work been divided into sections of moderate length, let by itemized bidding, the final cost of the work would have been even less than it was. Why? Because the completeness of the original estimate and of the adequacy of the plans based upon it. Had the survey been less thorough, or the study of the problems made in haste, no lump sum bidding would have saved the day. Moreover, tt should be remembered that the one firm which bid upon the subway contract, was bidding not merely for work but for a 50-year franchise. Had contracts been let after inadequate surveys, innumerable bills for "extras" and lawsuits based upon deceptive borings would probably have resulted, following the history of both public and private contracts of magnitude where subsurface surveys have been omitted or hastily made. Bills for "extras" are as just when made under a lump sum contract as any other, and have always been allowed by the courts where it could be proved that plans were changed or where the data furnished by the engineers were grossly deceptive. The lump sum contract possesses just one important advantageous feature, it reduces, if it does not wholly eliminate, any claims for extra compensation based upon erroneous classification of the excavated material. The same result, however, can be accomplished in other ways, where it is deemed desirable.

Why do contractors show a preference for itemized bidding? And why should itemized bidding result in lower prices in the long run? The answers to these queries may be summarized in a list of objections to the lump sum method of bidding, as follows:

1. To the contractor the requirement of a lump sum bid appears on its face to be a confession of haste or carelessness in making the surveys and plans.

2. The contractor knows that in the course of a few days or weeks he cannot hope to check all the surveys made by the engineers, which may have taken months or years, and he resents the attempt to make him responsible for the accuracy of the engineering work. He is very apt, therefore, to add a good percentage for insurance against what appear to him to be risks, covering also the costs of possible lawsuits.

3. The contractor hesitates to bid upon work where there is uncertainty as to the amounts that he will receive on monthly estimates. Lump

sum bidding, where there is a multitude of items, leaves the size of the monthly payment almost entirely to the judgment of the engineer, on public work of magnitude where there is likelihood that the engineer who is in charge at the beginning will not be in charge at the end of the work.

4. By virtue of the foregoing, contractors of long experience on public works may not bid at all, or, if they do bid are apt to bid so high as not to secure the work.

5. Lump sum bidding gives no basis for payment for extra work due to increased quantities resulting from changes of grade, alignement, or designs. If the engineer's allowances for such extra work are not satisfactory, the burden of the proof in case of a lawsuit is upon the contractor. This, as well as the cost of a lawsuit, is a serious objection to the lump snm bid, in the eyes of the contractor.

6. If extra work is done on force account plus a percentage for profit, the contractor will have no objection, but, in view of the decreased efficiency of men on force account work, the cost will be excessive.

7. Public work done either by force account or under a subsidiary agreement between the engineer and the contractor, often leads to charges of collusion and fraud even where there is no foundation in fact for such charges.

8. Lump sum bidding, for reasons above enumerated, is apt to limit the competition to those local firms who know the engineer and the conditions of the work better than outside firms do. In a word, it scares away many responsible firms,

9. Finally, lump sum bidding does not disclose what experienced contractors consider to be fair unit prices, thus perpetuating engineers' errors in estimating unit prices.

In the long run this would prove one of the most serious objections to the lump sum method.

We see that there are many serious objections to lump sum bidding and that most of them are founded on the assumption that the character of the work actually done will differ from the character of the work as predicted. Now, if it turns out that the character of the work actually done does not differ from the predicted character, there is absolutely no argument left in favor of lump sum bidding, although we still have left several arguments against it; for should there be no change of route. grade, or plans, and should the material excavated be exactly of the kind and quantity in the engineer's original quantity sheet, there can be no "extra work," no unbalanced bids, no lawsuits, whether the contract be by lump sum or by unit prices. On the other hand, should changes in or additions to the original plans be made, a lump sum contract cannot save the municipality, state or government from ultimate payment of the additional cost—usually with the cost of legal expenses in addition.

In closing we may say that engineers should not seek to escape from the results of errors in their estimates of cost by attempting to put the burden upon the contractors. But they should stand firmly by their best judgment, always demanding time and money sufficient to make such surveys and studies of the engineering problems as will enable them to make accurate estimates of quantities and costs. Then, let them not hesitate to assume full responsibility for their estimstes, seeking neither to excuse any error nor to saddle it upon the backs of contractors by lump sum bidding requirements coupled with contract clauses that are often so one-sided and unjust as to make contracting almost synonymous with gambling.

Molecular Weight Determinations by Means of Platinum Thermometers.

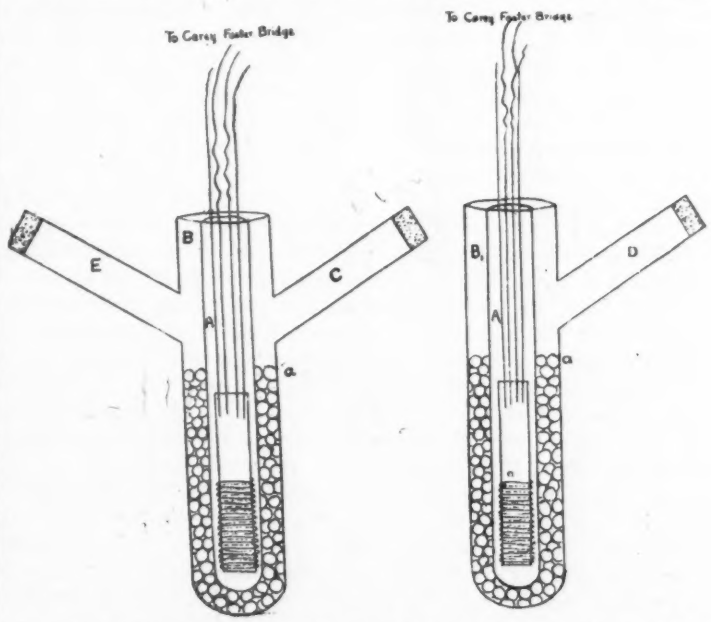
Messrs. H. T. Barnes, E. H. Archibald and D. McIntosh (McGil University of Montreal, Can.), in a communication to the *Journal of the American Chemical Söciety*, say:

In the course of an extended investigation on the properties of liquefied gases, we found it necessary to determine the molecular weights of some substances dissolved in these liquids for the purpose of comparison with conductivity measurements; and since these measurements were to be made at temperatures as low as −80° C., we were compelled to modify the apparatus ordinarily used.

We have, therefore, used platinum thermometers; and as these have only, so far as we are aware, been employed in determinations of the rise in boiling point by Noyes and Abbott, and that by a different method, we give here a description of our apparatus and some results of determinations of the molecular weights of inorganic salts when dissolved in water.

Our bridge was of the Carey-Foster type and of such a resistance that 1.670 cm. on the bridge wire represented a difference in temperature of 1° C. in our platinum thermometers; with the galvanometer used the bridge could be read with certainty to 0.5 mm., *i.e.*, to 1/30° C.

The method,[1] as will be seen from the diagram, was a differential



one. Two thermometers, exactly equal in resistance, each consisting of about 1 meter of 6-mil wire wound on a mica frame are, with their compensating leads, placed in the two tubes A and A_1, which are closed at the lower end and sealed into the larger tubes B and B_1. B and B_1 contain glass beads to prevent bumping and are filled with the solvent to the mark a, the amount in A being carefully weighed. The tubes are connected through C and D to condensers, E is tightly stoppered and the apparatus is heated in an air or oil bath. When the liquid is boiling freely the zero point of the bridge is found, and a weighed portion of the substance whose molecular weight is to be determined is introduced into A through the side arm E. The point at which the galvanometer shows no deflection is then ascertained, and from the data the molecular weight is calculated in the usual manner.

The following determinations with the chloride, nitrate, and sulphate of potassium were made with water as solvent.

Determinations ($K = 510$).—*Potassium Chloride.*

Salt.	Rise of B. P.	Molecular Weight.	
0.835	0.42	37.0	H_2O = 27.4 grams.
1.622	0.81	37.3	
2.295	1.19	35.9	
2.900	1.54	35.1	
	Potassium Nitrate.		
1.691	0.54	58.3	H O = 27.4 grams.
2.207	0.67	61.3	
2.685	0.85	58.8	
	Potassium Sulphate.		
0.887	0.28	82.4	
1.570	0.53	77.1	H_2O = 19.6 grams.
2.344	0.86	70.9	
2.960	1.08	71 3	
3.693	1.29	74.5	

The apparatus is convenient and in some ways much superior to that in which mercury thermometers are used, since neither adjustment for liquids having different boiling points nor tapping device is necessary; changes in atmospheric pressure can introduce no error and the thermometers can be made of any degree of sensitiveness required.

Chinese Coal Developments.

Engineering reports that with the approaching completion of the railway to Taokou on the Wei river, it will be possible to tap the enormous coal deposits of Shansi and Honan, and bring the fuel to the coast at a price which will make it impossible for imported coal to compete with it. Concerning the quality of the coal deposits in these two provinces of China there can be no question. Thirty years ago, Baron von Richthofen, after an elaborate examination at the instance of the Shanghai Chamber of Commerce, stated that both anthracite and bituminous would compare favorably with the best Pennsylvania and South Wales varieties; and further investigation by the engineers of

1. For temperature measurements with platinum thermometers, see Barnes; *Trans. Roy. Soc.*, Series A, 199 (1902).

the Pekin Syndicate and other bodies have confirmed his conclusions as to the value and the extent of the deposits. Hitherto the proper exploitation of these fields has been retarded by their distance from the coast, and from rivers that are unfit for navigation other than small boats; and, further, by the fact that the whole of the formation rests, as it were, upon a platform raised a few thousand feet above the adjoining plain. The construction of the railway obviates both these difficulties. The line is 75 miles in length, and runs from Tawang to Taokou, where there is water communication, by means of the Wei River and the Grand Canal, with Tienstien in the north. A dock and some 800 feet of wharf accommodation have been provided at Taokou for the loading of coal. Towards the southwest it is intended to extend the railway to Hsintien, in the plain of Honan, to which place most of the commerce of Southern Shansi is conveyed, and towards the northeast another extension is to be made from Twang to about Tzechaufu in Shansi, through a country whose mineral wealth—not of coal alone, but of iron also—is simply incalculable. There is a large trade opening as well with the interior of China as with the coast, and this is capable of indefinite expansion, the position permitting of a great reduction on present charges for fuel in both quarters. Freight to the coast at Tientsin by railway and Grand Canal will be 10s. per ton, and the coal is proat the pit at from 1s. to 2s. 6d. per ton. As the present price for good steam European coal on the coast ranges from 30s. to 40s. per ton, it will be apparent that the Chinese fuel has a great advantage—the quality being equal, and of that there is no doubt. Coal used locally increases in cost by hand, mule, and camel carriage about 2½d. to 5d. per mile, depending upon the condition of the roads, whereas railway carriage will cost ¼d. per ton per mile. The Pekin Hangkow Railway runs through the coal fields, and when completed—about two-thirds are already constructed—it will be possible to land coal on the Yangtse river, where another big outlet is assured. The Honan Nankin Railway is still in the clouds, and may be disregarded for the present, although ultimately it will permit of shipments to Shanghai. Meanwhile, Taokou is near the Yellow river, by means of which fuel can be carried to Tsinan, whence there is a railway to Kiao-chau. When the necessary lines are completed the cost of carriage to Nankin will be about 10s. per ton, and to Shanghai (which imports close to about 1,000,000 tons annually) very little more.

The known coal fields of China are estimated to cover 400,000 square miles; but few of them are worked, and most of those few only for local consumption. The field which has been best developed hitherto is that of Kaiping, which runs for 20 miles along the Tientsin-Newchwang Railway, with which it has its own connecting line. In this district there 60,000,000 tons in sight, and a further 265,000,000 tons (estimated) as yet undeveloped; the railway touches the port of Chin Wan Tow, where there are wharves, coal dépôts, etc.; and by means of a private canal of 15 miles, constructed by the old company, communication is opened up with the south and other parts of the country by means of the Grand Canal and the rest of the elaborate system of internal waterways. The deposits in Shansi cover nearly 14,000 square miles, and are scattered over a plateau from 2,000 feet to 3,000 feet above the sea level. It is estimated that the quantity of fuel waiting to be mined is 630,000,000 tons. Iron of high quality occurs abundantly in several strata of the coal formation. The Honan deposits have an area of about 21,700 statute square miles, about one-half of which is covered by sedimentary deposits. The available quantity, which is sufficiently large to be going on with, is divided into two nearly equal proportions, called the Lui River and the Sang River coalfields, the former yielding anthracite, the latter bitminous fuel. The coal is mined in the largest quantities on both sides of the river between Yung-hing-hein, a point a few miles north of Lui-hing-hein. The best fuel has hitherto been raised from some comparatively new mines a few miles east of Lui yang, which is 38 geographical miles distant from Yung-hing. The "coal of Lui-yang" (the name by which it is known in the lower country) is of great purity.

As may be readily imagined, the old methods of mining in the country are not favorable to the complete exploitation of its coal. Still, a certain proportion is consumed in the province, and some even reaches the coast. It is impossible to form any exact estimate of what the sales of coal in the neighborhood of the mines and in the country opened up by the railways will be, but they ought certainly to be very large; for not only will prices be lower than now, but the coal will be taken to a part of the country very densely populated, where the only fuel at present available is grass and stubble. The winters are severe, and if cheap coal is procurable the people will gladly buy it. Besides, when an unlimited supply of cheap coal is available, it is quite certain that industries now impossible, owing to the dearness of fuel, will spring into existence all over the country. The Chinese are an adaptive people, and once they are provided with proper facilities for trade, they will certainly make the most of them. No reliable information is procurable as to the quantity exported by water from Wei Hui. At present the price is so exorbitant that only the wealthy can afford to buy. But once the price is reduced to a reasonable figure the demand is likely to be very large, as the population is extensive and fuel scarce and dear. With improved communications such as will be afforded by a railway from the mines to the nearest point on the Wei river, from which navigation is open, and a service of lighters and steam tugs, coal can be placed at the several towns along the river and canal at a price which will bring it within the reach of the bulk of the population, and still leave a large margin for profit. At Po-tou, for instance, 468 miles from Wei Hui, anthracite coal from Chinghwa (Siu Wu) mines is sold at 101s. per ton, whereas with improved transport it could be sold for one-fifth that price at a profit of about 10s. per ton. The numerous navigable waterways connecting with the Wei river and the Grand Canal will afford cheap transport to the densely populated area intersected by them, and would open up a large mart.

It is expected that a large iron manufacturing trade may be created in the vicinity of the coal fields. Shansi is rich in iron ore, which occurs abundantly in several strata of the coal formation. The natives use only one kind, which melts easily without the aid of any flux. It consists of a mixture of clay, iron ore and spathic ore, together with hematites. Tse-chau-fu and Ping-tang-chau are the two principal centers of manufacture. The methods commonly adopted by the Chinese for the production of cast and malleable iron are rude and feeble enough, but the iron produced is generally allowed to be of excellent quality—a result attributable to the superiority of the raw material. It is not difficult to foresee the difference which will be made to the material wealth of this part of the empire by the introduction into the heart of the coal and iron district of works equipped with modern machinery, and made easily accessible by railway communication. The essentials are there—an iron of great purity, rich in metal and fusible, all sorts of clay and sand, such as are required for crucibles, moulds, etc., and a very superior anthracite. It is estimated that pig iron can be produced in Shansi at about 20s. per ton, and that it can be placed at Shanghai (which does a large trade in iron goods) at 63s., whereas imported pig sells there now at £5 per ton.

The United States Patent Laws: Historically and Practically Considered.[1]

Several years ago a writer in the *Iron Industry Gazette*, an English publication, said: "Disparagement of patents is common and easy, but it should not be forgotten by those who sneer at inventions that, out of a total of 8 billions of capital invested in manufacturing in the United States, patents form the basis for an investment of about 6 billions. Evidently, the United States system of encouraging invention that has resulted in the patenting of over 500,000 inventions is a system which is exceedingly wise and valuable. The only thing that has enabled manufacturers to make so wonderful a progress in the United States is its patent system."

Up to the present time there have been granted in the United States nearly 800,000 patents, and, while I have no recent figures, there is no doubt but that the proportion of capital invested in manufactures with patents as a basis is as great, if not greater, now than it was when the foregoing statement was made.

At a time when the right of property in patents, or rather in patented inventions, is so well recognized, it strikes one as a curious fact that there ever was or should have been a time when a right to such property was not recognized. Yet the fact is that in comparatively recent periods, considered in the light of the world's history, property rights in connection with inventions were not recognized, and if a man was possessed of an inventive turn of mind and was an inventive genius, and made inventions or improvements in machines or in mechanical devices or in the art of doing things, he had to stand by and see others enjoy equally with him the benefits of his intellectual thought and effort.

In the very earliest history, the right of property in tangible things was recognized, but an exclusive right in intellectual property, such as inventions and writings, was not regarded as a natural right, and the right to such property was only established as a result of advancing and improved civilization.

It seems that quite early in England the practice grew up under which the Crown, as a matter of grace and favor, but not of right, granted to

1. Communicated by Mr. C. N. Anderson, at a stated meeting of the Franklin Institute.

the inventor of a new manufacture or a new art, the exclusive right for limited periods to his invention or improvement, and it is reported that in the 14th century, in the reign of Edward III., some wise subjects of the realm, alchemists they were, invented or discovered a philosopher's stone. A commission was appointed by the King, consisting of two aldermen and two friars, who, after an investigation, which, of course, was very carefully made, reported that the philosopher's stone possessed merit, and upon this report the King granted an exclusive right to the discoverers to manufacture and sell the philosopher's stone.

When the nature of intellectual property is considered, it seems somewhat anomalous that rights of property therein should not have been recognized from the very earliest times.

Prof. Shaler has said: "When we come to weigh the rights of the several sorts of property which can be held by men, and in this judgment take only the absolute questions of justice, leaving out the limitations of expedience and prejudice, it will be seen clearly that intellectual property is, after all, the only possession in the world. The man who brings out of nothingness some child of his thoughts has rights therein which cannot belong to any source of property."

Mr. Fessenden, in his work on patents, published in 1821 says: "In a moral as well as in a political point of view, the author of a new and useful invention has the best of all possible titles to a monoply of the first fruits of his ingenuity. The invention is the work of his hands and the offspring of his intellect; and after he is allowed a temporary monopoly, becomes at the expiration of the patent a valuable donation to society."

At least as early as about the year 1600 the right of property in invention was well understood and had a well established and defined standing in the common law. As indicating that in the common law of England at that time the reason for granting exclusive privileges to inventors, and that the rights of property in inventions were fairly understood, I will read you what was said by the Court in the case of Darcy *vs.* Allin: "Where any man, by his own charge and industry, or by his own wit or invention, doth bring any new trade into the realm, or any engine tending to the furtherance of a trade that was never used before—and that for the good of the realm; that in such cases the King may grant to him a monopoly patent for some reasonable time, until the subjects may learn the same, in consideration of the good that he doth bring by his invention to the commonwealth; otherwise not."

Sir Edward Coke said of patent privileges that: "The reason wherefor such a privilege is good in law is because the inventor bringeth to and for the commonwealth a new manufacture by his invention, costs and charges, and therefore it is reason that he should have a privilege for his reward (and the encouragement of others in the like) for a convenient time."

It does not appear that there was any statutory law passed in England concerning the patenting of inventions until the year 1623, in the 21st year of the reign of James I., at which time the statute of monopolies was passed, which declared certain monopolies to be void, and prohibited the grant of such monopolies in the future. One section of this statute, however, related to patents and read as follows:

"Provided also, and be it declared and enacted: That any declaration before mentioned shall not extend to any letters patent and grants of privilege, for the term of 14 years or under, hereafter to be made, of the sole working or making of any manner of new manufactures, within this realm, to the true and first inventor and inventors of such manufactures, which others, at the time of making such letters patent and grant, shall not use, so as also they be not contrary to the law, nor mischievous to the state, by raising prices of commodities at home, or hurt of trade or generally inconvenient: The said 14 years to be accounted from the date of the first letters patent or grant of such privilege, hereafter to be made: but that the same shall be of force as they should be, if this act had never been made and of none other."

I quote this section of the statute in full because it is the first English statute on the subject, and is the very foundation of our own laws on the subject of patents. These laws are the result of development and evolution.

Mr. Robinson, the author of one of our most elaborate treatises on the subject of the patent laws, has said that in this statute, as interpreted by the English courts, are found the sources of the patent laws of the United States.

The 150 years following the statute just referred to covered the colonial period of the United States. During that period of our existence there was, as is well known to all, very little manufacturing within the present borders of the United States, and very little improvement in the manufacturing arts was made by the Colonists. The country was very thinly and sparsly settled; the Colonists, our forefathers, had duties to perform which were more pressing upon them than the making of inventions or improvements in the method or art of doing things in the manufacturing world. The Colonists were making a continual fight for existence and constant efforts to subdue the many obstacles incident to the development of a new country, and had no time to engage in the fascinating and frequently profitable pursuit of making improvements and inventions in existing devices in the manufacturing arts.

It is not surprising that under these conditions the Colonists made few inventions But there was still another obstacle in the way of improvement by the Colonists of the manufacturing arts. This obstacle was the attitude of England toward the Colonists upon this matter. It was England's idea that the Colonists should supply raw articles of commerce, such as the products of the farm, and that England should furnish to the Colonists all such manufactured articles as might be needed or demanded by the Colonists. England's policy toward the Colonists was expressed by Sir William Pitt, when he said: "It is the destiny of America to feed Great Britain, and the destiny of Great Britain to clothe America." Lord Chatham said, "I would not allow the Colonists to make so much as a hob nail for themselves"

Laws were enacted by England prohibiting every species of manufactures in the Colonies. When the Colonists began to make iron and nails for their use, the House of Commons resolved that "none of the plantations should manufacture iron nails of any kind out of any sows, pigs, whatsoever." And the House of Lords added, "No forge going by water, or other works, should be erected in any of the plantations for the making, working or converting of any sows, pigs, or cast iron into bar or rod iron."

By an act of 1750 the erection of buildings and mills for making iron was prohibited. There were corresponding restrictions imposed upon the Colonies with respect to all sorts of manufacturing arts. For instance, in 1684, Virginia passed an act encouraging the manufacture of the textile fabrics which was annulled by Parliament. The condition of manufactures in the Colonies has been well set forth by Senator Thomas C. Platt, of Connecticut, as follows:

"Manufactures were practically unknown; * * * there were no machines as we now understand the term; * * * men knew how to plough and sow, hoe and chop, reap, mow and cradle, break flax and hackle it, thresh with the flail, winnow with the blanket or fan and to shell corn by hand. The women knew how to spin, card, weave and knit. Mechanical knowledge was monopolized by the blacksmith, the carpenter, the millwright and the village tinker. Production was a toilsome, weary task, limited by the capacity for muscular endurance."

It is probable that the first patent granted within the limits of the United States was by the general court of the Colony of Massachusetts, under date of May 6, 1646, to one Joseph Jenckes, of Lynn, for a scythe. In his petition or prayer, he prayed for protection for "Fowerteen yeeres, without disturbance by any other setting up the like inventions, so that his study and cost may not be in vayne or lost."

Before proceeding to a discussion of the laws relating to patents which have been enacted by the United States Government, I desire to call attention briefly to some of the objections which have been made to patents. The objection has been made that there is no such thing as intellectual property, and that ownership of such property restricts common rights. Also that the granting of a patent is a creation of a monopoly. Patents have been compared to letters of marque, which allowed the holder to prey upon honest industry. It has been urged that patents increase the price of commodities, and that they encourage labor-saving inventions and take opportunities from the artisan.

It is needless to say to an audience of the present day that the last objection is utterly without foundation. Exactly the reverse has been proved adequately. It has been urged that patented inventions reduce or sink man to automata, and that the granting of a patent enables one man to say to another that he shall not carry on his business in the best way, and that by granting a patent the idea involved in the patent is tied up, and the course of thought in that direction is stayed. A Frenchman has advanced a picturesque objection that patents give undue advantage to their possessor by "making a golden bridge for him who enters the arena with arms more subtle and more finely tempered than those of his adversaries."

The foundation of all the patent law legislation in the United States is the clause or phrase in the Constitution which vests in Congress power "to promote the progress of science and useful arts by securing

for limited times to authors and inventors the exclusive right to their respective writings or discoveries."

The first patent law of the United States was enacted in the year 1790, April the 10th. It followed in a general way the law then in existence in England authorizing the grant of patents without an examination of the prior art, as is now the case. The authority to grant patents was conferred upon the Secretary of State, the Secretary of War and the Attorney-General of the United States.

It appears that Mr. Jefferson, who was at that time Secretary of State, took great interest in the patent laws, and regarded them and the granting of a patent as of the very greatest importance, and he is generally referred to as the Father of the United States Patent Laws.

In the *Official Gazette* of the United States Patent Office, published September 24, 1877, an interesting description of the early practice under the Act of 1790 occurs: "By Act of April 10, 1790, the first American Patent System was founded." Thomas Jefferson inspired it, and may be said to have been the Father of the American Patent Office. He took great pride in it, it is said, and gave personal consideration to every application made for a patent during the years between 1790 and 1793, while the power of revision and rejection granted by that Act remained in force. It is related that the granting of a patent was held to be in these early times quite an event in the history of the State Department, where the clerical part of the work was then performed.

It is a matter of tradition, handed down to us from generation to generation, by those who love to speak of Mr. Jefferson, his virtues and his eccentricities, that when application for a patent was made under the first Act, he would summon Mr. Henry Knox of Massachusetts, who was Secretary of War, and Mr. Edmund Randolph, of Virginia, who was Attorney-General—these officers being designated by the Act, with the Secretary of State, a tribunal to examine and grant patents—and that these three distinguished officials would examine the applications critically, scrutinize each point of the specification and claims carefully and rigorously. The result of this examination was that during the first year a majority of the applications filed failed to pass the ordeal, and only three patents were granted. In those days every step in the issuance of a patent was taken with great caution, Mr. Jefferson seeking always to impress upon the minds of his officers and the public that the granting of a patent was a matter of no ordinary importance.

It is not to be understood that the examination referred to an investigation of the prior art. The only examination was of the petition, description, drawing, etc., of the application.

The next patent act was amendatory in its nature, and was passed in 1793. Among other changes, it imposed the duty of issuing patents upon the Secretary of State, subject, however, to the approval of the Attorney-General.

From 1792 down to 1836, various unimportant amednments to the patent laws were enacted. In the last mentioned year, however, the first comprehensive law was passed relating to the grant of patents. This law remained in force until 1870, and was in fact in substance very much the same as our present laws.

By the enactment of 1836, a sub-department of the State Department was created, which was known as the Patent Office. Provision was made for the appointment of a Commissioner of Patents, and the Commissioner of Patents was required to make or to have made an examination of the alleged new invention or discovery to determine whether or not the same had been invented or discovered by any other person in the United States prior to the alleged invention thereof by the applicant and to determine whether or not, in view of the prior art, the applicant was entitled to a patent.

Prior to this Act examinations were not required, and if the applicant averred that his alleged invention was new and novel, the Commission or the Secretary of State was required to grant or issue a patent upon his application, provided the discovery or invention of the applicant was deemed of sufficient importance.

It will readily be seen that a patent granted under such circumstances was necessarily of very small commercial value, because it would not be reasonable to expect men to invest their capital in a species of property, good title to which and the value of which were so uncertain.

The Act of 1836 established patent property upon a higher plane than it had ever before occupied, and it is believed that the importance of this act to the people of the United States cannot be overestimated.

Senator Thomas C. Platt, speaking in 1884, referring to this Act, said:

"To my mind, the passage of the Act of 1836, creating the Patent Office, marks the most important epoch in the history of our development—I think, the most important event in the history of our Government from the Constitution until the Civil War. The establishment of the Patent Office marked the commencement of that marvelous development of the resources of the country which is the admiration and wonder of the world, a development which challenges all history for a parallel; and it is not too much to say that this unexampled progress has been not only dependent upon, but has been coincident with the growth and development of the patent system of this country. Words fail in attempting to portray the advancement of this country for the last 50 years. We have had 50 years of progress, 50 years of inventions applied to the everyday wants of life, 50 years of patent encouragement and 50 years of a development in wealth, resources, grandeur, culture, power which is little short of miraculous. Population, production, business, wealth, comfort, culture, power, grandeur, these have all kept step with the expansion of the inventive genius of the country; and this progress has been made possible only by the inventions of its citizens. All history confirms us in the conclusion that it is the development by the mechanic arts of the industries of a country which brings to it greatness and power and glory. No purely agricultural, pastoral people ever achieved any high standing among the nations of the earth. It is only when the brain evolves and the cunning hand fashions labor-saving machines that a nation begins to throb with new energy and life and expands with a new growth. It is only when thought wrings from nature her untold secret treasures that solid wealth and strength are accumulated by a people."

To be Concluded.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. David R. Francis, President of Superior Jury, of the recent World's Fair, St. Louis, Mo., has inclosed the following to "The Bristol Company," Waterbury, Conn., which explains itself: "Pursuant to the rules and regulations governing the system of awards, formal public announcement is hereby made that a gold medal has been fully awarded you on your exhibit of recording instruments in Group 71. A medal and diploma for this award will be issued by the Exposition Company, as soon as ready."

Mr. D. R. Swing, formerly of Charlotte, N. C., has been appointed Superintendent of the Columbia (S. C.) Gas Light Company, at which spot it is proposed to make many improvements this season. The generating plant (it is of the water gas type) is to be remodelled and due heed is to be given to main extensions.

Mr. Hogshead, Mr. Swing's immediate predecessor at Columbia, has returned to Lynchburg, Va.

It is said that the prospect for another war of gas rates in San Francisco is imminent. The present rate ($1 per 1,000) would seem reasonably cheap, even though the Coast has oil to burn.

Mr. H. C. Hutchinson has resigned the position of Manager of the Promotion Department of the Cincinnati Gas and Electric Light Company. We understand that his successor is Mr. Edward Miller, whose appointment is likely traceable to the effort of Mr. John Kilgour.

At the annual meeting of the Chambersburg (Pa.) Gas Company the Directors chosen were: A. Buchanan, T. M. Nelson, Irvin C. Elder, M. C. Kennedy, George H. Stewart, Chas. O. Wood and Walter K. Sharpe.

A correspondent in Springfield, Mass., incloses the following: "An interim meeting of the owners of the Hadley (Mass.) Gas Company was held some days ago. The financial statements presented made it appear that the gross earnings since the last meeting have amounted to 6 per cent. on the stock; net earnings were 4.6 per cent. Instead of declaring a dividend, the stockholders voted to use the surplus funds in the business. The time for the annual meeting was changed to July, to which time all the present officers will continue in office. A request for an extension of the mains on Russell street was considered, but no action was taken upon it."

At the special election of the voters of Mexico, Mo., called for the purpose of determining whether or not a gas plant franchise should be granted, only 10 votes were cast in the negative.

A charter for the Citizens Gas Company, of Monongahela, Pa., has been filed in the office of the State Recorder. The concern proposes to

supply gas in Carroll, Fallowfield, Somerset and Union townships and Monongahela, Washington county, and in Forward township, Allegheny county. The Directors are: W. S. Shepler, G. M. Murphy, John Zeh, S. M. Downer and Jas. C. Corrin, all of Monongahela.

THE shareholders in the Youngstown (O.) Gas Light Company have, through their Directors, confirmed the naming of Mr. Henry W. Heady as a Director, succeeding Mr. Jay H. Perkins. Mr. Alexander Webb succeeds Mr. C. L. Root as Treasurer of the Company.

THE movement, happily completed, to construct a new gasholder for the plant of the municipal lighting concern at Richmond, Va., seems to be forerunning in the good work of enlargement. Now that the authorities may construct an adequate gasholder they are paying their attention to the idea that a new holder should have something up-to-date behind it. To sum it up, the authorities are considering the construction of a modern gas making plant in the West End of the city, and that could be done this season to the great benefit a year or so from now of the residents of Virginia's largest city.

AT the annual meeting of the shareholders in the Cranford (N. J.) Gas Light Company the Directors chosen were: John Kean, Julian H. Kean, F. A. Price, Francis Engel and H. B. Udell.

THIS information is not from Mr. Andrew K. Quinn, of the Newport (R. I.) Gas Company, but we nevertheless believe it is accurate, in that it comes from a source that often reaches his desk: "While New York, Boston and other large centers of population are contending for a reduction in gas rates, Newport was given a reduction yesterday (4th inst.) without blowing of trumpets or horns by the Newport Gas Company. When the monthly bills were put out yesterday and scanned by the consumers it was found that the net price had been changed to $1.20 per 1,000 cubic feet, instead of $1.30, which has been the price heretofore. The gross price is $1.50 per 1,000 feet, which is the same as heretofore, but those who pay their gas bills within 10 days have the extra advantage of 10 cents per 1,000 feet, making 30 cents saved instead of 20 cents in the past."

MESSRS. O. P. BRICKER and John H. Myers, of Lancaster, Pa., and James C. Keen, of Philadelphia, have been granted a charter for the operating of a Company to manufacture and distribute gas in the towns of Litiz, Manheim, Ephrata, Akron, Marietta, Lincoln, Pottsville and Warwick, Pa. The corporate title of the concern is the Litiz, Manheim and Ephrata Gas Company.

THE Rev. S. H. C. Smith, who resides on Main avenue, Asbury Park, N. J., and who has likely to stay in that "beautiful" spot all the year round, was an attendant at the New Year's reception of the Ocean Grove Association. When Bishop Fitzgerald had told them much about what the Grove had done for others (and themselves) Mr. Smith had a chance to speak and this is what he said in part: "They (the Grove owners) have done many things for which they deserve commendation, and they will do more. Give us gas, for instance." The appeal and suggestion were greeted with louder applause than was that which followed the Bishop's announcement that the Grove year had been a profitable one.

PERHAPS some good "Groveite" will ultimately move to send its present electric lighting plant to Point Pleasant—if anyone there will take it.

THE Board of Gas and Electric Light Commissioners has authorized the Lowell, (Mass.) Gas Light Company to issue 500 shares of additional capital stock, at the upset price of $145 per share.

MR. W. T. MORRIS and associates, of Penn Yan (N.Y.) have purchased the franchise and properties of the Lyons (N.Y.) Gas Light Company.

THE proprietors of the Chuctanunda Gas Light Company, of Amsterdam, N. Y., have put the gross selling rate at $1 per 1,000 cubic feet—a rebate of 25 cents per 1,000 to rule for prompt payment within 15 days. The rate is effective after March 1st.

MR. FRED M. SHELLEY has resigned from the service of the Rome N.Y.) Gas, Electric Light and Power Company.

FOR the benefit of "flopper" Grout, who is now in the employment the taxpayers of New York city, serving them as Comptroller, we would like to call his attention to the fact that the municipal gas works at Hamilton, O., may be placed in the hands of a receiver. The city has not paid the Standard Oil Company for stuff purchased that was used for gas making purposes by the city for something over 10 months.

THE authorities of Wilmington (Del.) are said to be considering the advisability of trying to run a gas plant on public account.

AS a result of the purchase by the city of 300 shares of stock in the Consumers Gas Company, of Toronto, Ont., the Mayor has been elected a Director in the named corporation.

MR. A. W. KENDALL, formerly connected with the Elgin (Ills.) American Gas Company's staff, has accepted a position with the Rochester (N. Y.) Company.

MR. A. L. ENGLISH has been appointed Manager of the Citizens Gas and Electric Company, of Council Bluffs, Ia., vice Mr. W. P. Beyerle, who has been appointed to a responsible position in the service of the Maryland Telegraph and Telephone Company.

AT the annual meeting of the Hartford (Conn.) Gas Securities Company the following officers were chosen: Directors, E. B. Bennett, Atwood Collins, S. R. Bertron, Lucius F. Robinson and Emery S. Lyon; President, E. B. Bennett; Vice-President, S. R. Bertron; Secretary, Lucius F. Robinson; Treasurer, Security Company.

A CORRESPONDENT in New Haven, Conn., incloses the following: "At the annual meeting of the New Haven Gas Light Company the old Board of Directors was re-elected as follows: Geo. J. Brush, Pierce N. Welsh, George D. Watrous, Robert A. Brown, Charles H. Nettleton, A. Heaton Robertson, Winston J. Trowbridge, Frederick F. Brewster and Eli Whitney. President Nettleton, in behalf of the Directors, presented to the stockholders a brief statement concerning the new plant which is being constructed. It was reported that the work on the buildings is progressing, and it was hoped to have the new plant in operation by next April. The development of the Gas Company's plant has now reached the stage where the public can observe its magnitude. In addition to the mammoth gasholder on East street, which towers above the tallest factory building in that section of the city, the coal storage shed and retort house on Chapel street are well advanced toward completion. Several other buildings, smaller structures, are in course of construction. The Company has made plans for expansions and the details of these have been outlined by President Nettleton. The report made by the President was very gratifying to the stockholders. At the organization meeting of the Board of Directors Charles H. Nettleton was elected President; Pierce N. Welch, Vice-President; and Frank M. Travis, Secretary and Treasurer.

THE following is from the Baltimore *Sun* of the 4th inst.: "The financial plan in connection with the proposed consolidation of the Consolidated Gas Company and the United Electric Light and Power Company has been worked out in a general way, but the details have not been finally agreed to. The charter of the Consolidated Gas Company is broad enough to embrace the Electric Light and Power Company if such a method should be deemed advisable, but the interests in control of the properties have also under consideration the formation of a new Company which would absorb both the Electric Light and the Gas Company and have a capitalization sufficient to take in all the securities of both and as well to provide money for all future requirements. This corporation would directly operate both properties, and would have a capitalization of from $30,000,000 to $40,000,000. Another plan contemplates a holding Company, which would own the stocks of the two companies, and which of itself would not have as large a capitalization as the other plan would call for. The temporary financing covering the purchase of the Consolidated Gas Company has already been arranged, and, while there is no pressing need for hurrying the new financial plan, it is expected that it will be worked out within the next two months. Besides the Blair-Ryan-Brady interests, a number of leading New York banking houses will participate in the new financial scheme, and, while the control will be vested in the local end represented by the Alexander Brown Continental Trust Company interests, the outside capital will take care of a large part of the securities to issued. This arrangement is regarded as a favorable one from the local standpoint, as it will avoid congesting the Baltimore market with more securities than could be readily absorbed. It is felt that such an arrangement would also give a better and more stable market value to the new issues, which would in all probability find easy sale in the New York market. Considerable inquiry was made of President S. Davies Warfield of the Continental Trust Company to-day by holders of minority stock in the Gas Company as to the treatment proposed regarding their interests. Mr. Warfield assured these holders that their stock would receive equitable consideration and would have an opportunity to take part in the plan. The management of both properties will continue unchanged for the present, Gen. F. C. Latrobe is President of the Gas Company, and the General Manager is Mr. Alten S. Miller. The Electric Light and Power Company has also had satisfactory management of late, and no departure from the methods employed there is contemplated. Mr. F. C. Dreyer is President of this Company and Mr. Douglas Burnett is the General Manager. As the plan contemplates in any event a single corporation to control both properties there will be but one President to be selected, but there may be two general managers, or managing officers, for the two properties."

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The Market for Gas Securities.

There were some indications of a better market for Consolidated last week, and the net change for the time stated is a gain of 1½ points. The trading was comparatively light, but the great bulk of it was done on a firm basis. The mess over proposed investigation on State, county and city account respecting gas and electric rates, the standing of the Companies, etc., is in a nasty way, and the litigation that is sure to go on to the very end promises much funds for the law interpreters. City gas bonds are steadily sought for at advancing prices.

There is no change in Brooklyn Union, the quotations for which are strictly nominal. Laclede preferred is 90 bid. Peoples, of Chicago, is very strong, at 107⅞ to 107½; Baltimore Consolidated is a trifle weaker at 84½ to 85, and Washington, D. C., well holds its recent marked advance. Bay State has been showing some signs of life—the difference between buyers and sellers is thus shown: Bid, ⅜, offered at ½.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas stocks.
16 WALL STREET, NEW YORK CITY.
JANUARY 16.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	197¾	198¼
Central Union, Bonds, 5's.	3,000,000	1,000	108½	110
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Mutual	3,500,000	100	300	320
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co..				
Bonds, 5's	11,000,000	1,000	112	113¼
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	35	..
1st Mtg Gold Bds. 5 p. ct.	1,000,000	..	.	.
Northern Union, Bonds, 5's.	1,250,000	1,000	104	106
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	108½	108½
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	2 0	210
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	—	—
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	5¼
" " Bonds, 5's	5,250,000	1,000	66	68½
Capital, Sacramento Bonds (6's)	500,000	50	..	35
	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	107½	108
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	97½	99
Columbus (O.) Gas Lt. & Heating Co	1,682,730	100	88¼	89¼
Preferred	3,026,500	100	107½	109
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	84½	85
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	89½	92
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	75	75¼
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	104½	105½
" Bonds, 5's	10,500,000	..	107	108
Indianapolis	2,000,000	..	70	75
" Bonds, 6's	2,650,000	..	106½	108
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	..
Preferred	2,500,000	100	90	105
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	138	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105½
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	107⅞	107½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87¼	90
San Francisco, Cal.	15,800,000	100	58¼	58¾
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	94	96
St. Paul Gas Light Co	1,500,000	100	45	47
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Syracuse, N. Y.	1,975,000	100	50	55
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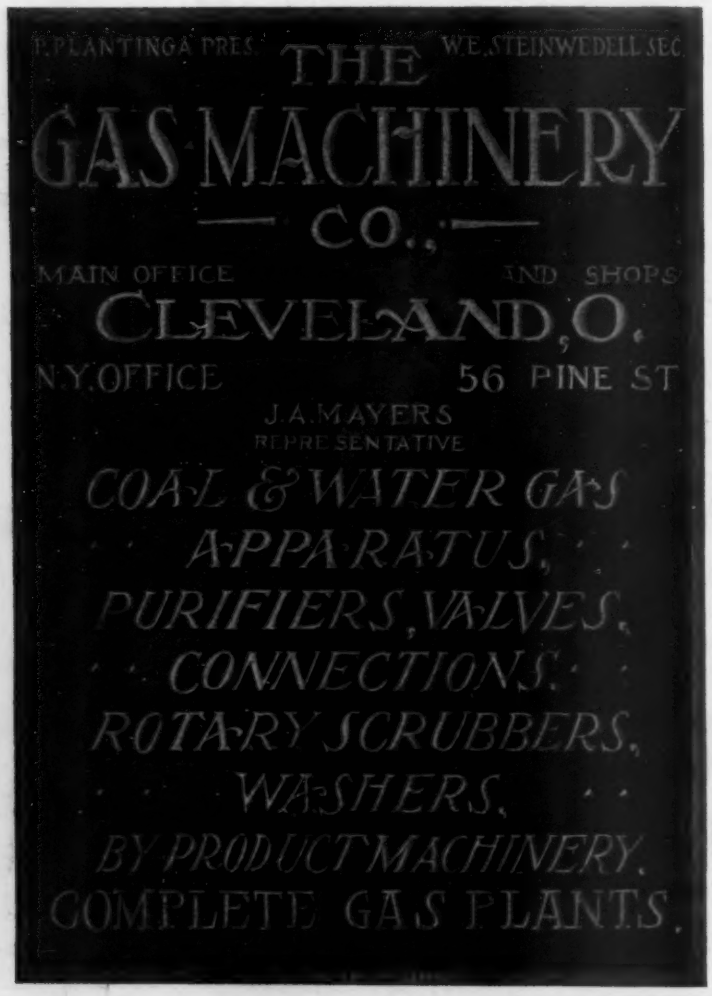

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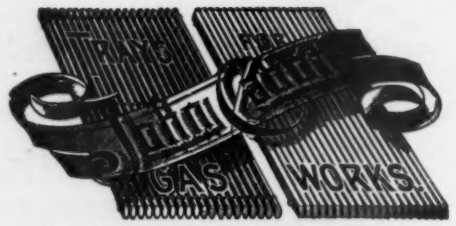

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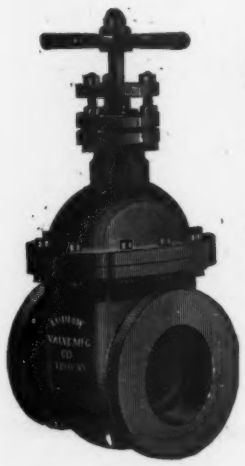

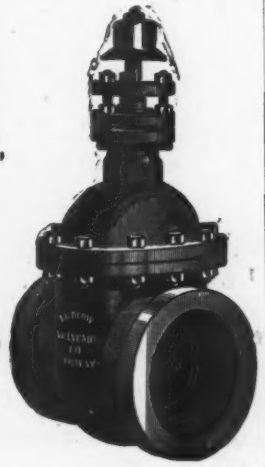

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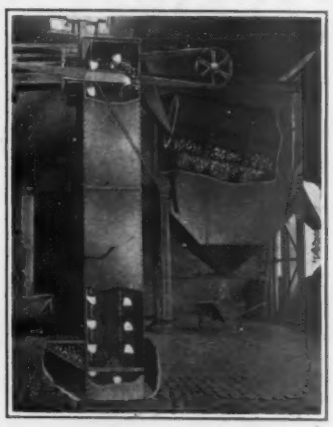

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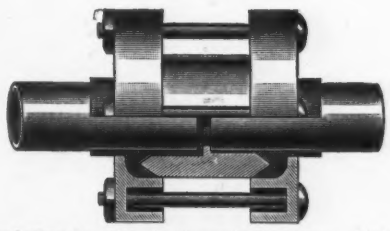
Patentee and Manufacturer of Specialties for Oil and Gas Lines.



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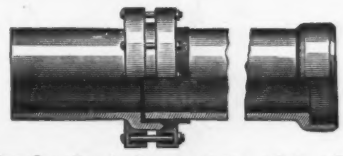

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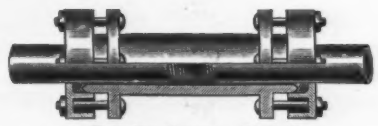
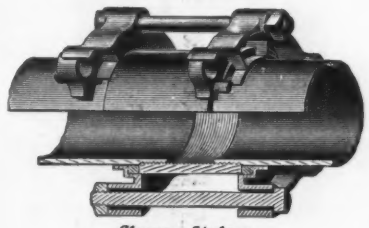
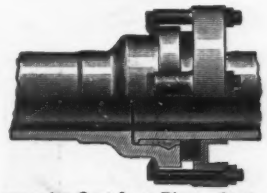


Regular Sleeve. Style 2.



Clamp. Style 4.



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Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

My Insulating Coupling prevents the destruction of pipe by electrolytic action, in either water or gas lines.

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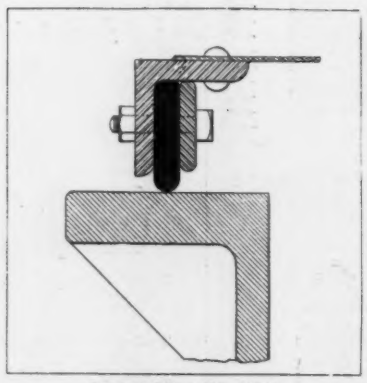

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In laying new mains, or in making a large number of taps in an old main, it is often advisable to use a dry pipe tapping machine and save the wear on a high priced pressure tapper.

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Mueller Dry Pipe Tapping Machines are made in several styles and sizes and for long or short tools. The machine illustrated is made for long tools and will make taps from ¾ to 3 inches on mains from 4-inch up.

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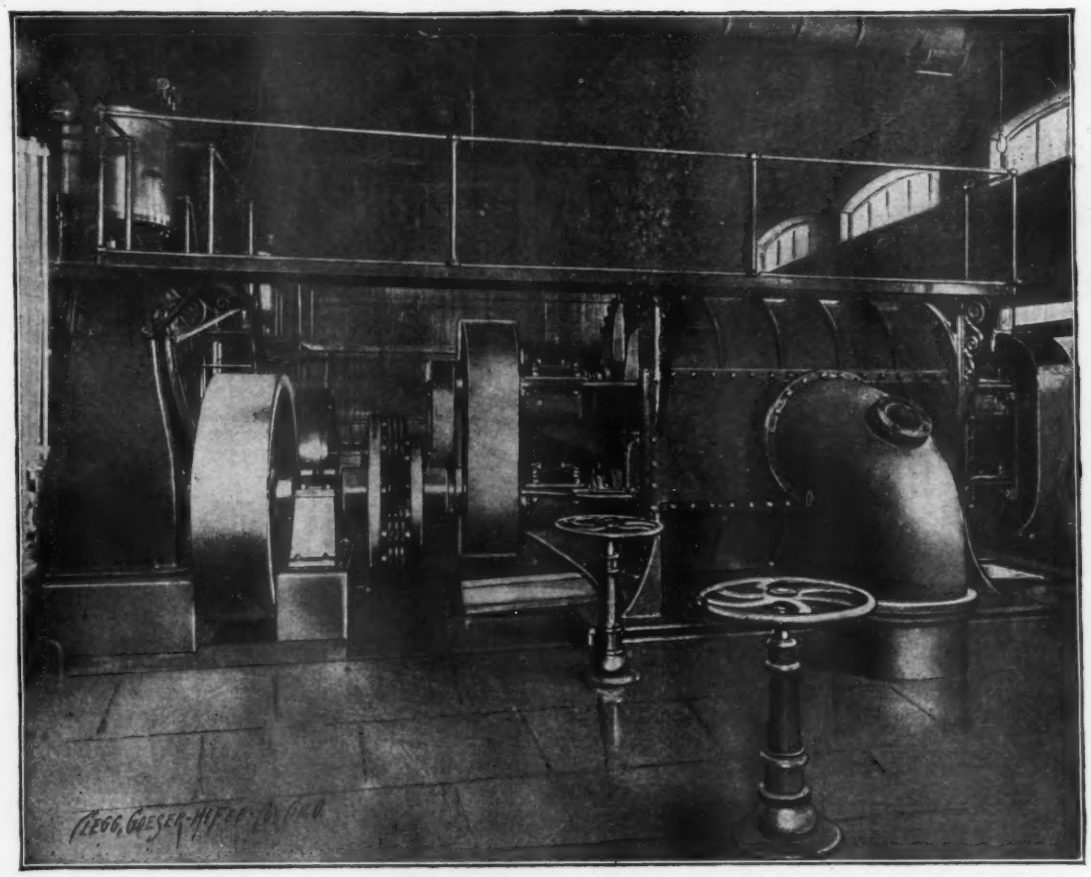

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Do you know That there is from **30 per cent.** to **45 per cent.** of heat, from coal used in making water gas, escaping via the stack valve unless your plant is equipped with

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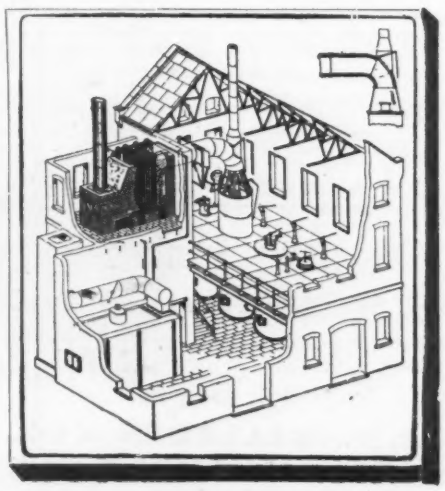

Do you know That in plants where it has already been installed the saving in fuel has been as high as 25 per cent.

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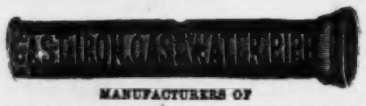

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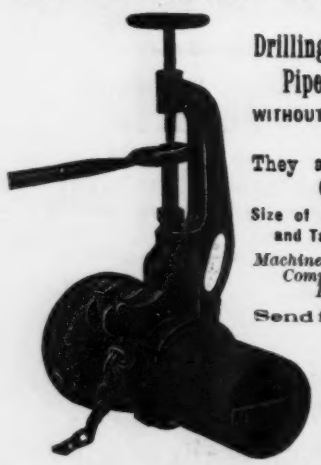

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Machines Sent to any Gas Company for Thirty Days' Trial.

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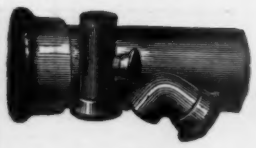

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FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF
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NO LEAKY JOINTS IN **UNIVERSAL PIPE.**

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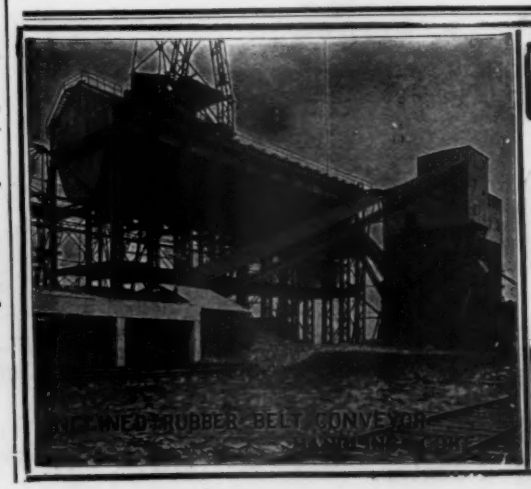
BARS FOR HAZELTON BOILERS.



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Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

FEBRUARY, 1905.

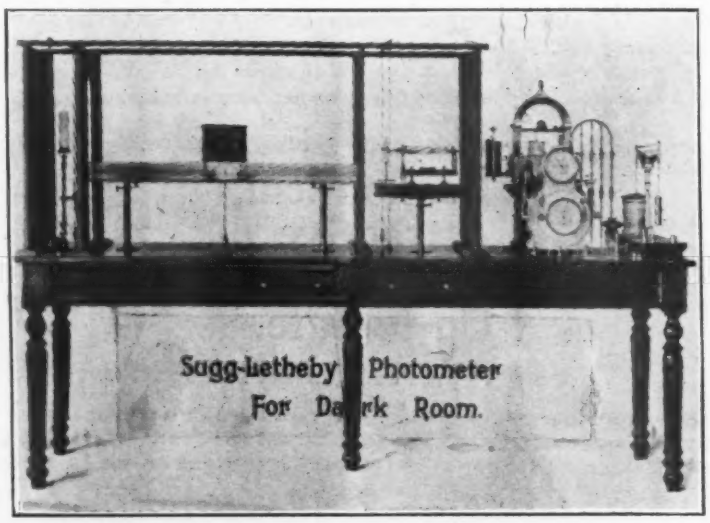
Table No. 1.
FOLLOWING THE MOON.

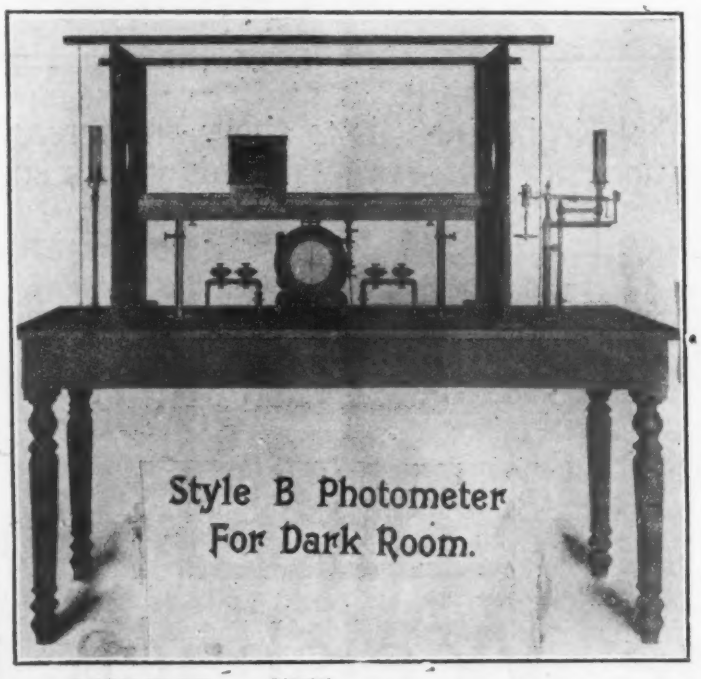
Day of Week.	Date.	Light.	Extinguish.
Wed.	1	5.50 PM	6.10 AM
Thu.	2	5.50	6.10
Fri.	3	5.50 NM	6.10
Sat.	4	5.50	6.10
Sun.	5	5.50	6.00
Mon.	6	5.50	6.00
Tue.	7	5.50	6.00
Wed.	8	8.30	6.00
Thu.	9	9.30	6.00
Fri.	10	10.30	6.00
Sat.	11	11.20	6.00
Sun.	12	12.20 AM FQ	5.50
Mon.	13	1.20	5.50
Tue.	14	2.10	5.50
Wed.	15	3.10	5.50
Thu.	16	4.00	5.50
Fri.	17	4.50	5.50
Sat.	18	No L.	No L.
Sun.	19	No L. FM	No L.
Mon.	20	No L.	No L.
Tue.	21	6.10 PM	9.10 PM
Wed.	22	6.10	10.30
Thu.	23	6.10	11.40
Fri.	24	6.10	12.40 AM
Sat.	25	6.10 LQ	1.50
Sun.	26	6.20	2.50
Mon.	27	6.20	3.40
Tue.	28	6.20	4.40

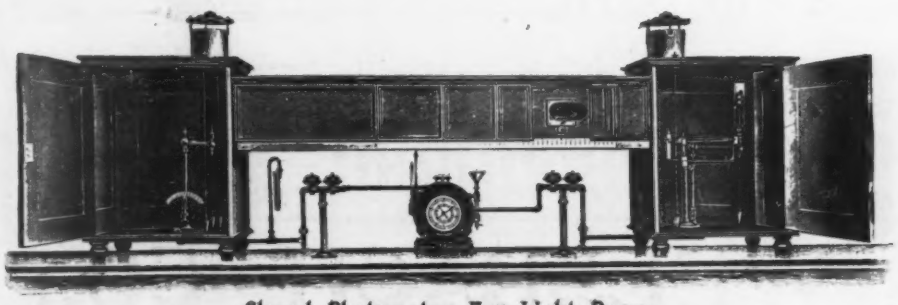
TOTAL HOURS DURING 1905.

By Table No. 1.

	Hrs.Min.
January	240.50
February	192.20
March	207.00
April	175.10
May	161.00
June	139.50
July	149.00
August	161.50
September	173.00
October	205.00
November	211.00
December	229.00
Total, yr.	2245.00







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

FEBRUARY, 1905.

Table No. 2.
NEW YORK CITY.
All Night Lighting.

Day of Week.	Date.	Light.	Extinguish.
		A M.	P M.
Wed.	1	5.05	6.15
Thu.	2	5.05	6.15
Fri.	3	5.05	6.15
Sat.	4	5.05	6.15
Sun.	5	5.10	6.10
Mon.	6	5.10	6.10
Tue.	7	5.10	6.10
Wed.	8	5.10	6.10
Thu.	9	5.10	6.10
Fri.	10	5.10	6.10
Sat.	11	5.10	6.10
Sun.	12	5.20	5.55
Mon.	13	5.20	5.55
Tue.	14	5.20	5.55
Wed.	15	5.20	5.55
Thu.	16	5.20	5.55
Fri.	17	5.20	5.55
Sat.	18	5.20	5.55
Sun.	19	5.30	5.55
Mon.	20	5.30	5.55
Tue.	21	5.30	5.55
Wed.	22	5.30	5.55
Thu.	23	5.30	5.55
Fri.	24	5.30	5.55
Sat.	25	5.30	5.55
Sun.	26	5.30	5.45
Mon.	27	5.30	5.45
Tue.	28	5.30	5.45

TOTAL HOURS DURING 1905.

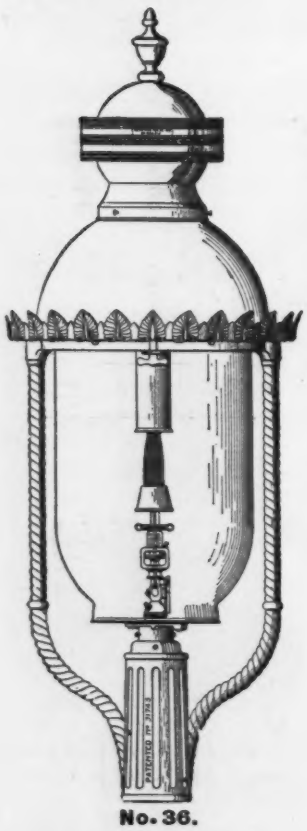
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 97 Liberty Street. BOSTON. 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Ree Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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Broad and Arch Sts., PHILADELPHIA.

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For the Period Ending July 31st, 1904, has been Awarded Contracts in the Following Places for

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Bangor, Pa.
Woonsocket, R. I. (2d contract).
Brooklyn, N. Y. (4th contract).
Cincinnati, O. (2d contract).
Scranton, Pa. (3d contract).
New York City (14th contract).
New Haven Conn. (2d contract).
Watertown, N. Y.
Tampa, Fla. (3d contract).
Westchester, N. Y. (3d contract).
Bridgeport, Conn. (2d contract).
St. Paul, Minn. (2d contract).
Harrisburg, Pa.
Pelham, N. Y.
Reading, Pa.
Springfield, Mass. (2d contract).
Lynn, Mass. (5th contract).

TOTAL SETS, 1904, ... 35
TOTAL DAILY CAPACITY, 1904, . . 50,400,000 cubic feet.
TOTAL SETS TO DATE, ...543
TOTAL DAILY CAPACITY, . . . 413,180,000 cubic feet.

The United Gas Improvement Company,

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Established 1858. Incorporated 1890.
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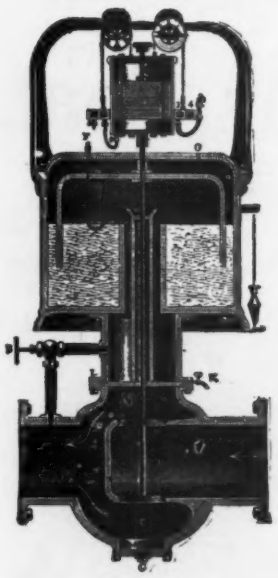

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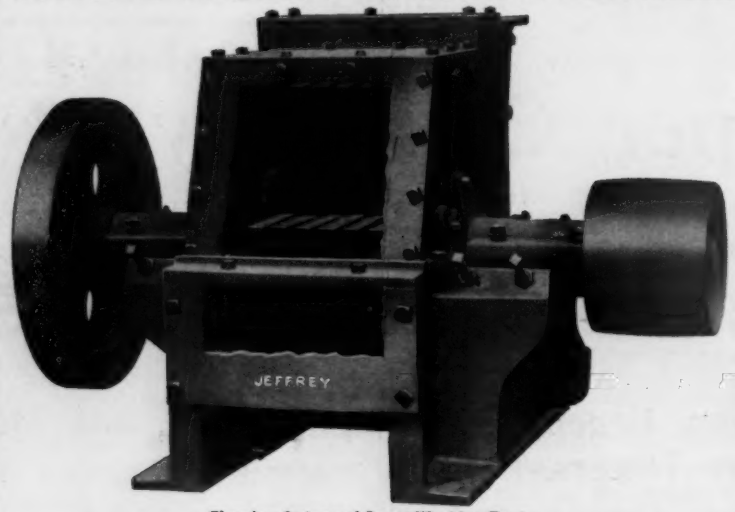

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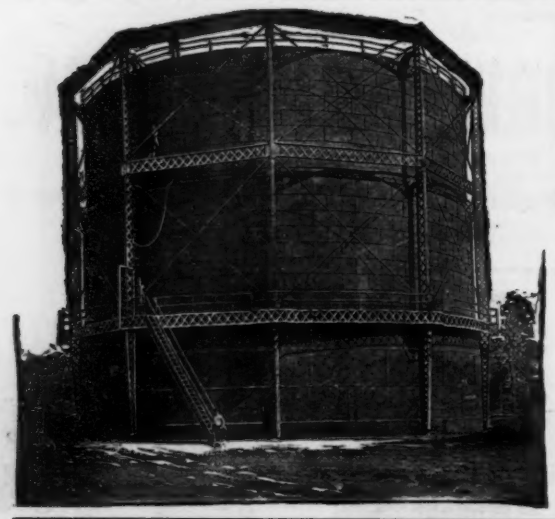

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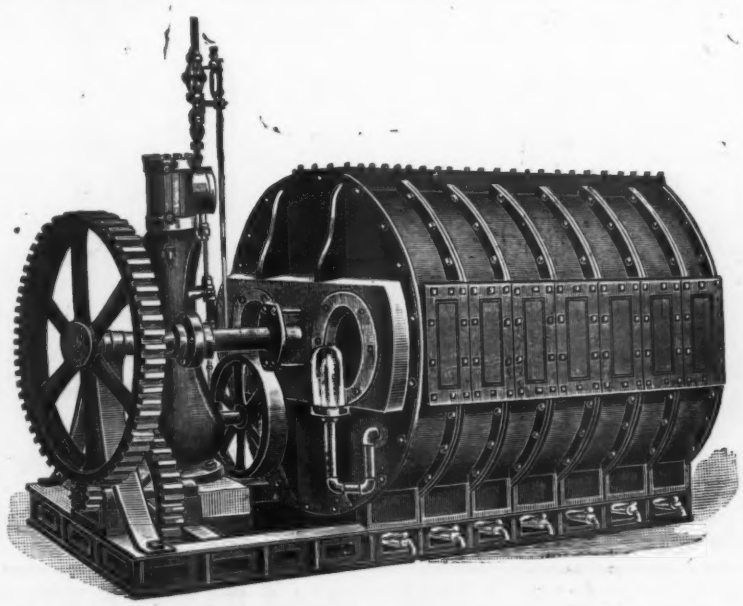

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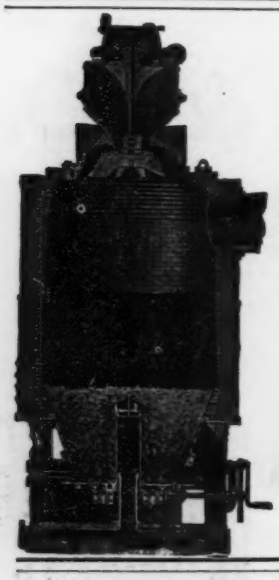

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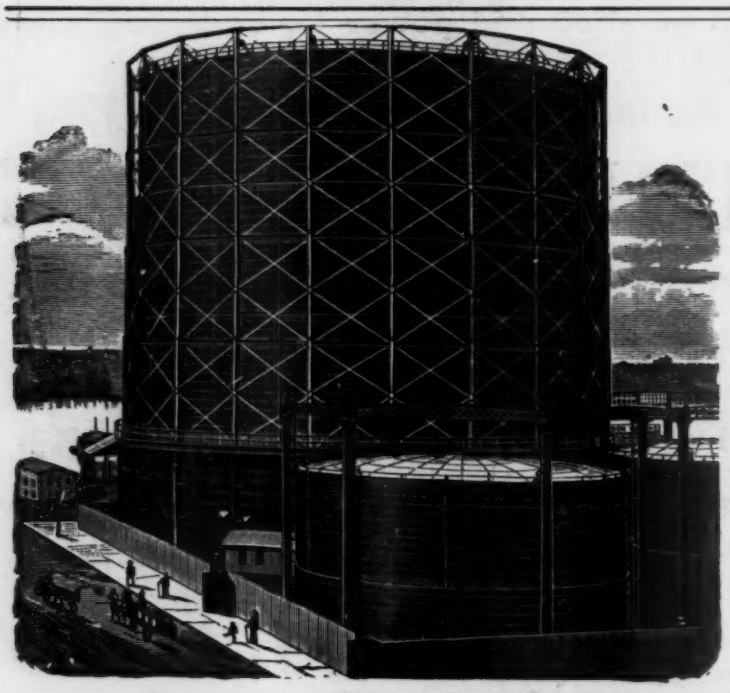

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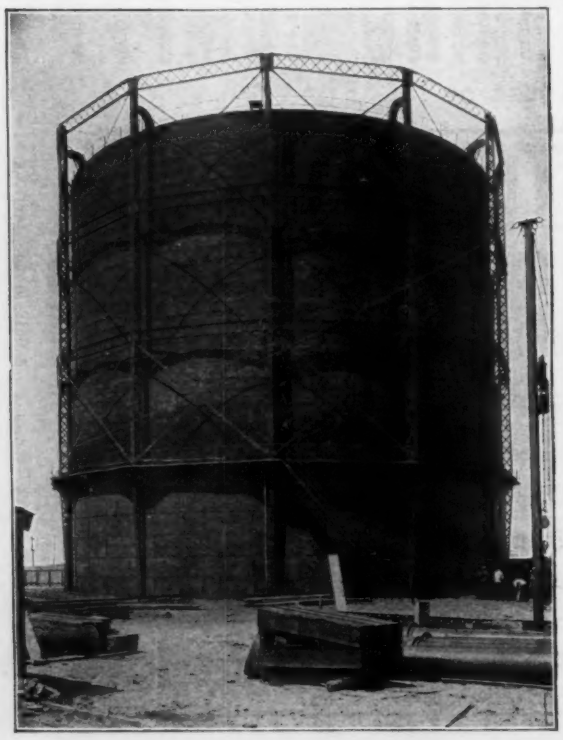

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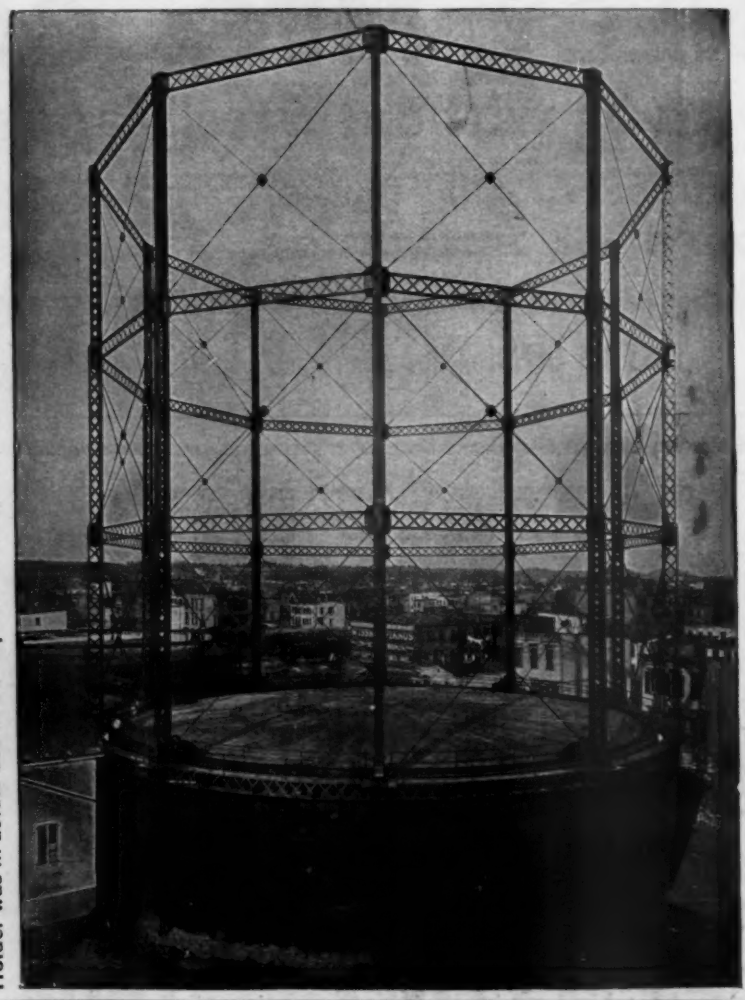

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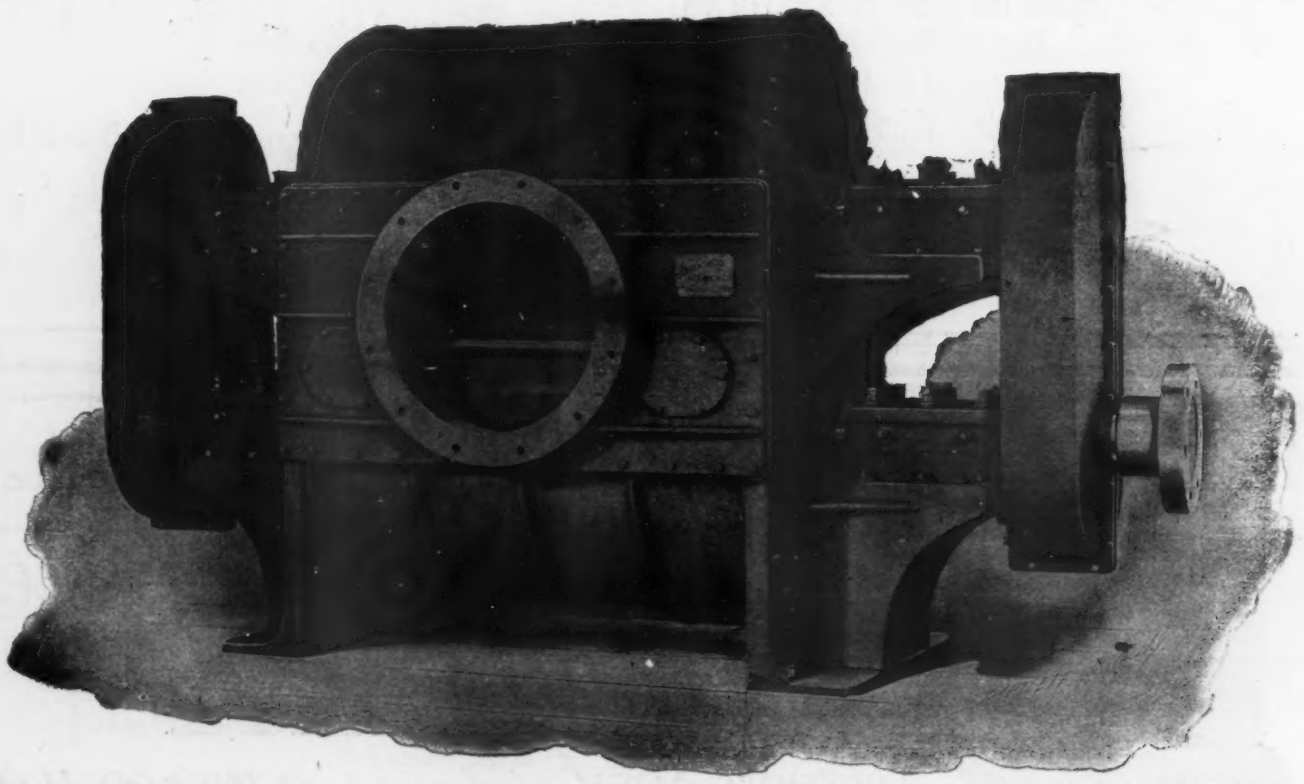

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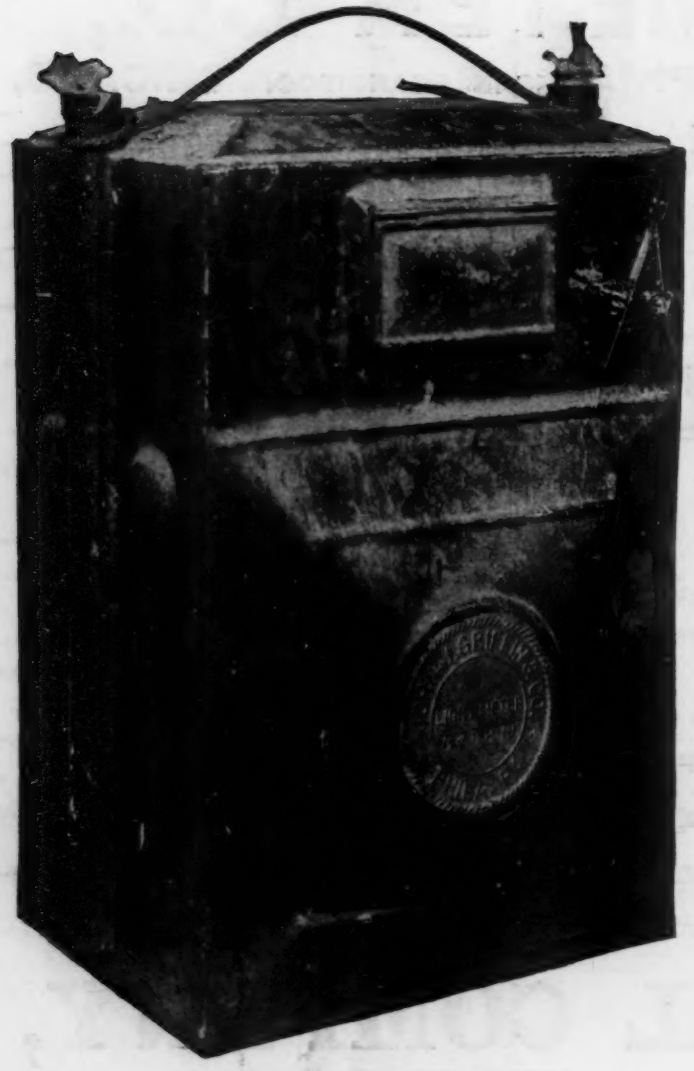

This is a photograph of a 3-light regular meter out of a lot of meters received from the Coatesville Gas Co., Coatesville, Pa., to be repaired and converted into prepayment meters.

AFTER.

This is the same meter after it has been repaired and converted into a new prepayment meter.

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